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Leaching Manganese by the Bradley Process

By Carl Zapffe

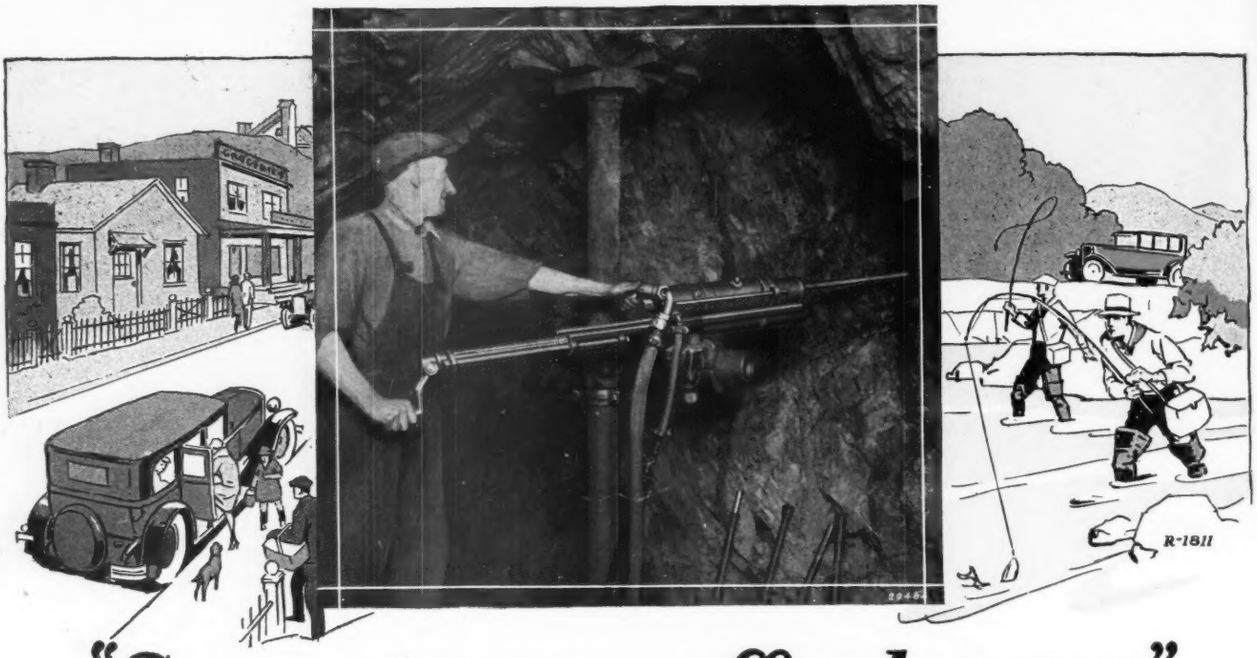
Reverse Classification by Crowded Settling

By F. C. Dyer

Chrome Resources of Turkey

An Interview with Leslie Urquhart

Tin-Plate Industry on the Pacific Coast



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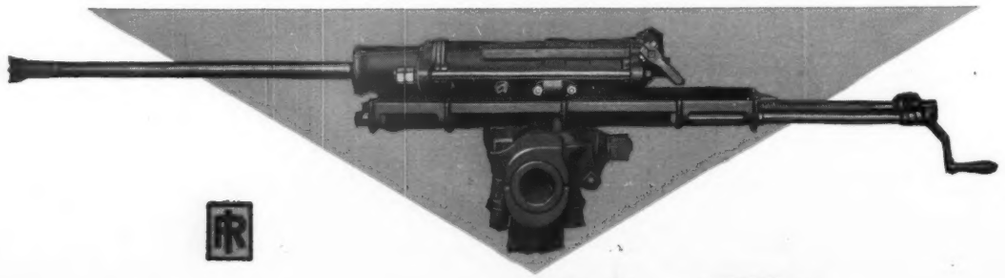

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Volume 127 *Number 26*

ENGINEERING AND MINING JOURNAL

A consolidation of "Engineering and Mining Journal" and "Mining and Scientific Press"

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New York, June 29, 1929

Features of *E.&M.J.*: XI—Index

IN THIS ISSUE appears a complete index to the current volume for the last half year. It is the best index *E. & M. J.* has ever published —complete, accurate, and well cross-indexed. Make use of it and save your time and ours in referring to back numbers.

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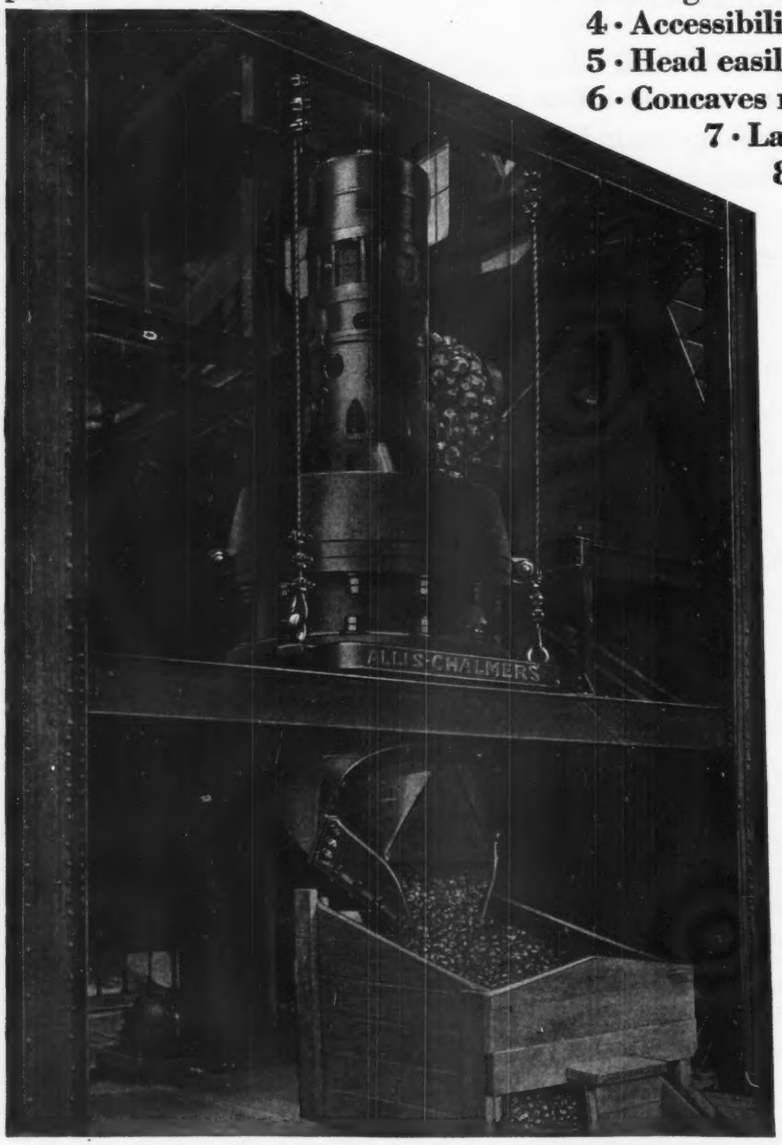

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Samples of crusher products have been taken to determine screen analysis under actual operating conditions. One of these is shown below. This sample was taken of the product of a 10″ machine crushing limestone and set at 1½″ open side. The analysis was made on flat testing sieves.

100.0% passing 2¼″ round hole
99.4% passing 2″ round hole
97.6% passing 1¾″ round hole
91.5% passing 1½″ round hole
78.4% passing 1¼″ round hole
63.7% passing 1″ round hole
48.9% passing ¾″ round hole
33.5% passing ½″ round hole
21.8% passing ¼″ round hole
13.4% passing ⅛″ round hole

Write for Style "B" Newhouse Crusher Bulletin 1469

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ENGINEERING AND
MINING JOURNAL

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Materials Deserve More Extensive Study

FIFTEEN YEARS AGO the efficiency engineer was at the height of his glory. Even commercial houses had their efficiency departments. "Efficiency" was a catchword; to practice it was a fad; and, as usually happens with anything that becomes too common, efficiency soon lost interest for the great majority. So rapidly did the efficiency engineer slip down in public esteem that he became the theme of frequent jokes. Industry did not become less efficient, however. Competition made it keep to the more difficult path. Efficiency is necessary to success.

Efficiency departments still exist, in mining as elsewhere. Some deserve the name more than others. The efficiency engineer of a certain large company in the Northwest is doing much to make operation more efficient, especially by a study of materials and supplies. Another result is the increased efficiency made possible in purchasing. Injudicious buying, the result of ignorance of materials, decreases profits to an extent generally unrealized. Authorities have stated that one dollar lost in purchasing is equivalent to a loss of ten dollars of sales, this being but the up-to-date variation of the saw that "a dollar saved is a dollar earned." Dividends make no distinction between these two kinds.

In contrast to the company mentioned, another in an eastern state has only recently established a research department. Here, in a long untouched field, it believes that opportunity exists to work out new methods and improved processes and to develop new uses for its products. Most of its work thus far has been the refining of present metallurgical practice. The intended scope of the department is wider than this, however, and a study of materials is on the calendar. In these the company has become greatly interested, especially in materials that resist corrosion. Study of those used in axles for ore skips, bolts for rod mills, and other structural parts, it thinks, will also prove of profit.

Adequate attention is rarely given to materials. Longer life, less frequent repairs, and better service are the benefits to be won by improving them or selecting them more wisely. Co-operation from the manufacturer of a high-class product will readily be had, for he is anxious to prove its superiority. By careful choice of materials one might rebuild a machine so that, like the famous one-horse shay, it would last for a hundred years and a day. But such ambition is out of place in this age of rapid changes, when the scrap heap often beckons long before the natural life of equipment has been attained. Corrosion and abrasion, however, work faster than invention, and in the aggregate run up a pretty bill, even where they are not ignored.

A Forward Step in Flotation Development

SETTLEMENT of the patent difficulties between the inventors and developers of the matless type of flotation cell, just announced, will be hailed with general satisfaction by the fraternity. It is particularly pleasant to be able to record that the agreement was arrived at without the long-continued court action and heavy legal expenses that have characterized some other flotation disagreements.

In the Sept. 26, 1925, issue of *Engineering and Mining Journal*, Mr. D. C. Forrester, mill superintendent of the Old Dominion, at Globe, published the first description of the machine that he had been working on to solve some of the difficulties experienced in the use of other flotation cells under the conditions obtaining at his plant. Instead of admitting the air through a porous mat of canvas, concrete, or other material, it was merely blown into the pulp at the bottom of a launder through a row of small open-ended pipes projecting down from a large supply pipe above. Appropriate baffles and spitzkasten were, of course, provided. The simplicity of the device assured low upkeep costs, and the freedom with which the air was released obviated the necessity of the four- to five-pound air pressure formerly required, with consequent reduction in power costs for compression. Metallurgical results compared favorably with those secured by other means.

Soon it became apparent that from the patent standpoint, Mr. Forrester was not to have clear sailing and for the last four years the use of this type of cell has been hindered greatly by the liability of users to suits for infringement, no matter what make of cell was installed. The Welsch patent covering an air-lift cell, granted in 1918, was developed and put on the market by the Southwestern Engineering Corporation. Other important patents in question were that of Dunn for a combined pneumatic and cascade type of cell, granted in 1917; those of Kohlberg and Kraut; and that of Hunt, of Miami Copper, who, in recent years has carried on a great deal of development work in cells of this type. The resultant legal situation can be imagined, and there has been an understandable disinclination by users of machines of this type to release any information regarding their installation or operation.

A holding company has now been formed to amalgamate the various interests involved, to be known as the Matless Cell Patent Holding Corporation, and the Southwestern Engineering Corporation has the sole right to license, manufacture, and sell the several machines of this type involved. Most of the installations have so far been made in the Southwest, with the Phelps Dodge Corporation perhaps in the lead in the number

of cells in use. The use of the cell may now be expected to spread much more widely, and it will offer active competition with the several other excellent and equally modern types of flotation equipment on the market. Local preferences and conditions vary, of course, and trial will be necessary to find out the best type of cell to install at a given property. American mining engineers are not slow to make such trials and to appraise the results properly. Congratulations are in order to all of the disputants who have found such a sensible solution to their difficulties, even though each probably feels that the individuality of his work has been submerged in the common pool.

Trade Conferences Protect Public From Unlawful Practices

ANY IMPROVEMENT made in the morality of business represents a certain gain to the public and to legitimate industrial interests, besides at the same time effecting the removal of that much unscrupulousness from the business world. Considerable has been accomplished in this direction by various agencies, and, in a broad sense, the rule of *caveat emptor* has long since been discarded.

That fraudulent practice and unfair dealings, however, continue to fleece the public of millions of dollars annually was disclosed in a recent address by Mr. W. E. Humphrey, a member of the Federal Trade Commission, a body charged with the responsibility of preventing unfair methods of competition in business, both as they affect the competitor and the public. This commission, although empowered by statute to issue an order against a violator to cease and desist from unlawful practices, has, in general, conducted its actions in accord with the theory that one of the most effective means of protecting the public is to help business rid itself of such methods. Following this plan, conferences were held at the suggestion of the commission by various industries, including some of the largest in the country. As a result of these deliberations, each of the industries concerned had an opportunity to "clean its own house," or, in other words, to achieve decency, instead of compelling the government to enforce remedial measures to bring about the same condition.

One of the most important of the trade practice conferences was that called to consider methods employed in the correspondence school system, which, owing to enrollments from the personnel of nearly all industries, is indirectly an influential factor in the industrial development of the country. Many complaints had been filed with the commission against these schools, and an investigation revealed that, of the $75,000,000 received annually as tuition by 300 institutions from 2,000,000 students, $35,000,000 went to schools guilty of misrepresentation and fraud. A conference was arranged and a code condemning all unfair practices was adopted. More than 85 per cent of the schools approved the code, and today it is observed by almost the entire group.

Besides protecting and aiding a large number of persons in their earnest endeavors to obtain an education, the commission has, in this instance, rendered a distinct service to industry and to society at large. The correspondence school system is an important component of the educational organization of the country, and proper conduct of its dealings with the public should be assured.

Publicity Insures Group Success and General Prosperity

GROWTH OF WEALTH in the United States has paralleled an expansion in power and influence and integrity of the technical press. No other agency has done more to point the way to improved methods, to lower cost of manufacture, to increased production and consumption. Strange it is that visitors to the United States should have overlooked an influencing factor of major importance in American success—the pooling of knowledge with a central agency entrusted with the task of digesting it and broadcasting the result to a nation-wide circle of readers.

An English observer, writing in *Round Table* (London) in 1926 sensed a difference between Old World and New World methods in this connection, when he said that, "What is raising the whole standard of management in the United States is the habit among employers of discussing their problems openly among themselves, of comparing the methods of one industry with those of another, and of founding associations for research and conference . . . They are not afraid to teach or too proud to learn from each other."

This is true, but the most effective vehicle for this teaching and learning is the technical press, without which the details of method and equipment adopted in connection with the outstanding examples of industrial progress would not have been available.

Individual patriotism, as opposed to economic advantage, is a weak means on which to rely to stimulate business in the event of depression. Speaking in Newcastle, England, recently, the Prince of Wales affirmed that "We [the British] could hardly hope to maintain the supremacy which we enjoyed during the nineteenth century, but I think that valuable time has been lost in looking back regretfully to the past and hoping that the spacious Victorian days would return." This statement is of deep significance—unpalatable perhaps in some quarters, but provocative of reform.

"To restore our economic prestige," the Prince continued, "we need courage and imagination—courage in ruthlessly scrapping all methods and machinery that do not come up to the most modern standards, and imagination in exploring every commercial avenue overseas."

This also is sound advice; but the scrapping of methods and machinery will be a slow process if all publicity in regard to the change or to the fruitful results of the change is *verboten*. The Prince should carry his investigations further, in an effort to determine the real cause and the economic effect of a determination to preserve, at all costs—even at the cost of group or national industrial depression—a policy that discourages the extension of modernization by creating a wrong impression that new tools are no better than old ones—in a selfish effort to prevent the competitor from gaining the same

advantage—to prevent a wider industrial prosperity. Thus it is that national propaganda urging the citizen to buy domestic in preference to imported goods fails in ultimate achievement because the details as to the benefits resulting from the purchase are deliberately suppressed.

The purchase of a piece of machinery of domestic make, for instance, may be a patriotic gesture. But if the buyer deliberately refuses to divulge the effect or the consequences of the purchase, he creates a suspicion that militates against industrial expansion and group prosperity by preventing others from judging between the efficient and the inefficient. The general public is in doubt, and the scrapping of the obsolete is delayed. This unpatriotic attitude more than neutralizes the apparent patriotism that prompted the purchase in the first place.

Flights of Imagination Are Prompted by "New Discovery"

PUBLICITY given to modern scientific methods of prospecting has stimulated many inquiries from the less erudite members of the profession for a device that will find ore without the expenditure of much mental or physical effort. In this day and age, a want is no sooner made evident than it is supplied, so no surprise was felt at seeing a magazine advertisement featuring an apparatus specifically designed for this purpose.

"Find Hidden Gold," proclaims the title. What is heralded as an "Amazing New Discovery" is described as "The Genuine Spanish Gold Digger Compass," which accurately locates "Hidden or Buried Gold and Silver; coins, jewelry, mines, etc., at unknown depths." The distance of the discovered deposit from the operator being unascertainable, one might question the value of the instrument; but the promotor evidently failed to consider this aspect of the problem. Presumably, the instrument would be equally available to determine the precious-metal resources of Mars, and equally incapable of effecting any commercial outcome.

The "new discovery" is simple to operate, one is told. Moreover, it has one great advantage over all other types of geophysical apparatus. It is most inexpensive. "Send No Money," implores the ad. "Pay Postman Special Introductory price Delivered: $2.72 for standard type, or $5.72 for Double-Strength type, for Professional Treasure Hunters and Prospectors."

If the apparatus operates at unknown depths, one wonders why any double-strength type is needed. The difference in price is small, however. "Beware of imitations," one is warned, and adjured to "Order Immediately," because "It may mean your fortune."

The base of distribution to the world of the credulous is Mexico City. This fact excites suspicion, for one doubts if the United States postal authorities can take action on the grounds that the mails are being used to defraud if the principals are domiciled in another country. Should these words meet the eye of prospectors or treasure hunters seeking a double-strength substitute for skill and labor, they are hereby advised to avoid any amazingly new discoveries in geophysical apparatus that can be purchased for $5.27 per unit.

The Small Unit, Also, Is Deserving of Attention

HOLY WRIT advises us not to despise the day of small things; but in this age of spectacular achievement one is prone to forget that the great in size usually comprises a multitude of small parts, the perfection of each of which insures the successful functioning of the whole. Despite the tendency toward bigness in unit size, however, a trend is in evidence to perfect what is small and complete, thereby indicating a pride in craftsmanship rather than a tendency to concentrate attention where profits are greatest.

Frequent necessity arises for the employment of small equipment, but rarely is the diminutive unit designed or manufactured with the same care that characterizes the production of machines of larger sizes. Among the many exceptions to this generalization, however, may be included a new type of internal-combustion engine, rating as low as one and a half horsepower. This is not a toy by any means. It has been designed for hard service, many features being incorporated to insure freedom from breakdown under continuous load, in addition to a relatively high efficiency of operation. The advantages of complete inclosure of the working parts, with the provision for automatic lubrication, are among its attractive features. It is compact: less than sixteen inches high, twenty-two inches long, and nineteen inches wide. Two pulleys are provided to allow a driving speed of either 1,500 or 750 revolutions per minute. A mechanical regulator permits a further reduction in speed if desired—at the sacrifice of power, of course. Thus is it possible to meet a wide range of speed requirements.

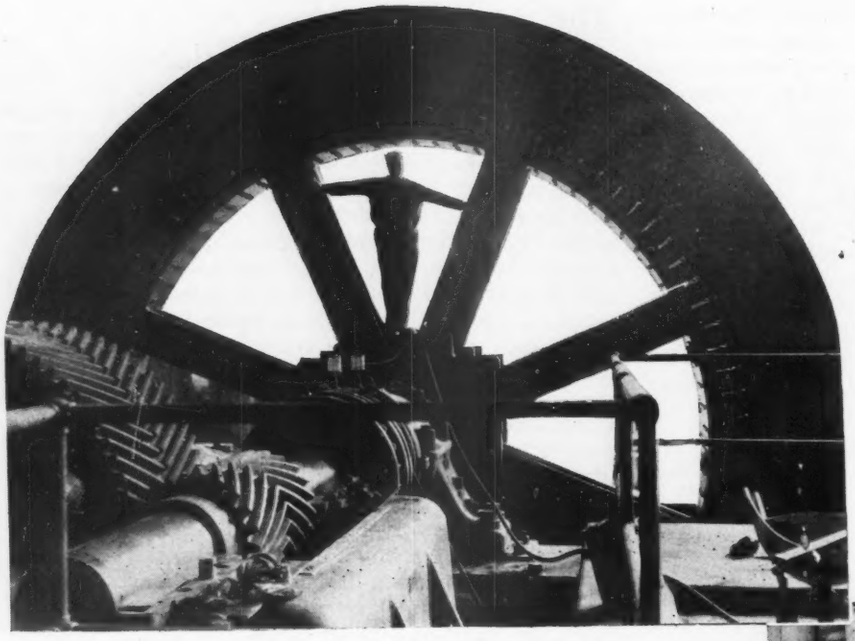
Simplicity is an important factor in the acceptance of any new unit. In this particular instance the makers have achieved success without added complication; in fact, the new engine has fewer parts than had its less efficient predecessor. One section may function in duplicate, the base casting serving also as an oil reservoir.

The small unit seldom receives the operating care and attention that is lavished on the larger one, with the result that its appearance usually creates an unfavorable impression. But personal supervision may be minimized by the thoughtful design of machinery in the first instance. For example, in the particular unit mentioned, the problem of the leakage of oil has been considered and solved. A partial vacuum is maintained within the crankcase, thereby guaranteeing a cleanliness that automatically insures better machine performance and greater personal satisfaction.

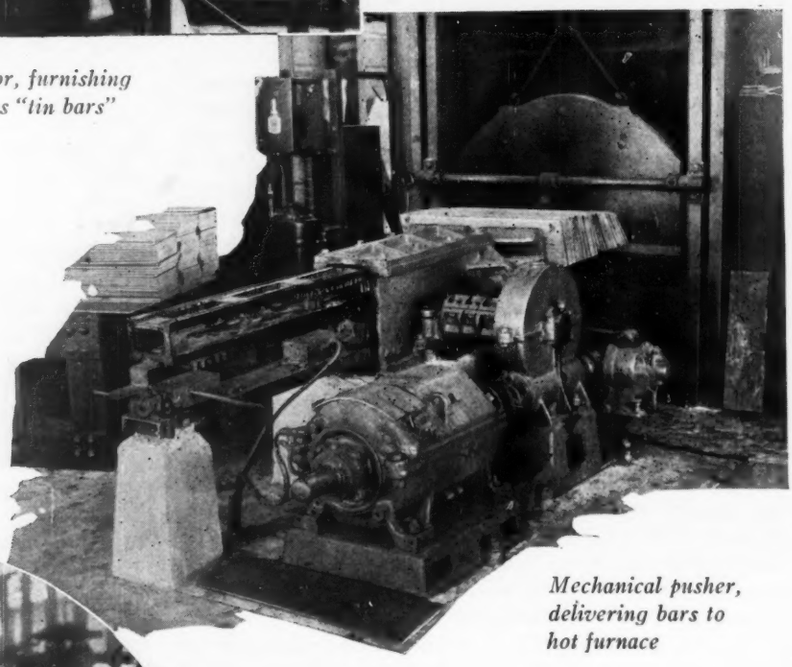
The keenest rivalry is being evinced by engineering inventors in the design of internal-combustion engines that will operate efficiently and continuously and with low fuel consumption and absence of excessive vibration. Numerous competitive types of balanced prime movers in this class are being evolved, tested and perfected.

Wide scope exists for the utilization of small individual power units, especially on mining properties away from the beaten track and out of touch with conveniences and facilities and a flexible electric supply. Pioneer work will be hastened and cheapened and made less laborious, and operations will be simplified, when greater recognition is paid to the fact that the small unit fills a definite want. The manufacturer is realizing that it should be as efficient, relatively speaking, and as serviceable as its bigger brother.

Coast Tin-Plate Industry Seizes Opportunity



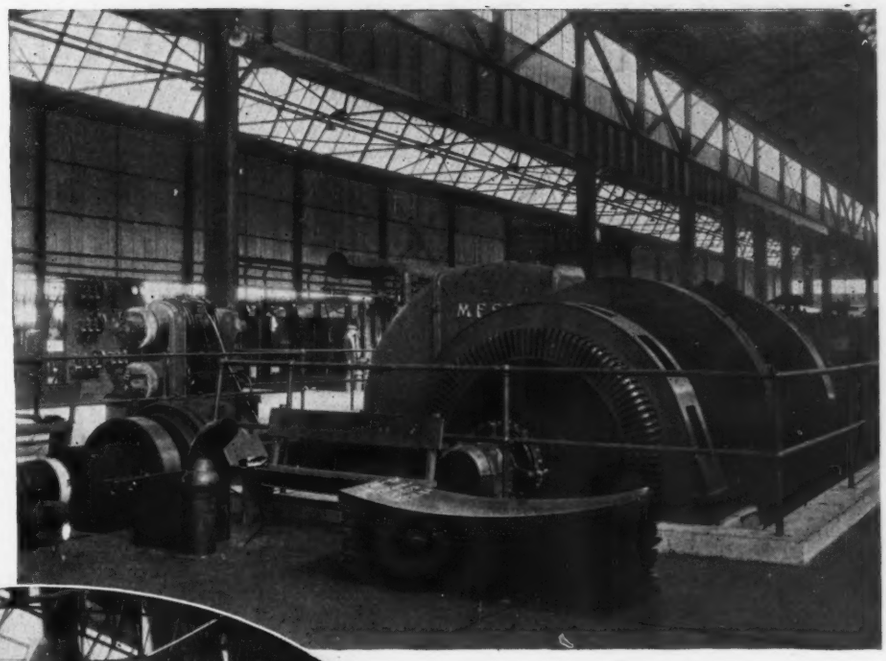
Gigantic 5,000-hp. Westinghouse motor, furnishing power to produce what are known as "tin bars"

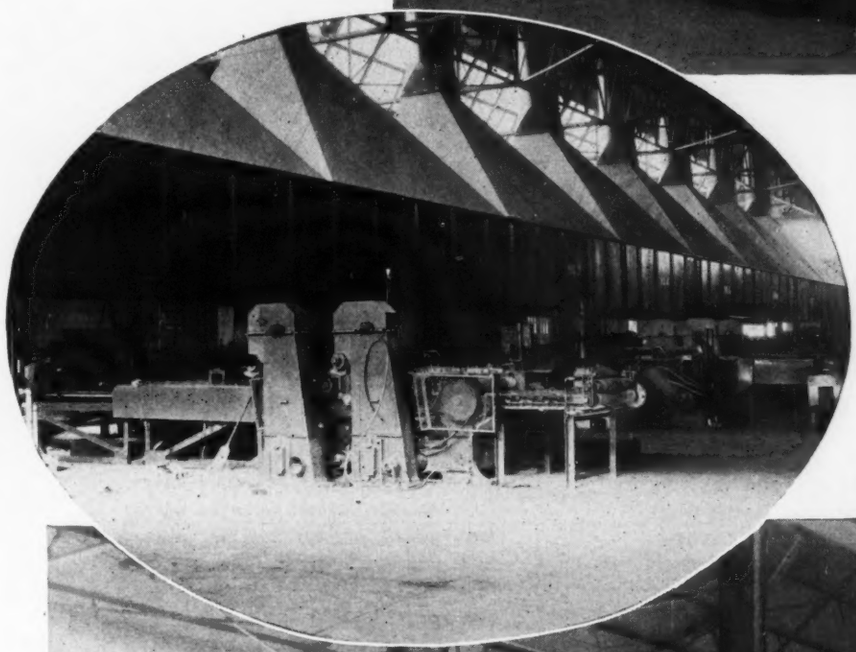


Mechanical pusher, delivering bars to hot furnace

Atmosphere around the mills and furnaces is cooled for the benefit of the workers. Note ducts.

Views of the New 2½-Million Dollar Plant of the Columbia Steel Corporation at Pittsburg, Calif., With an Annual Output of 38,000 Tons

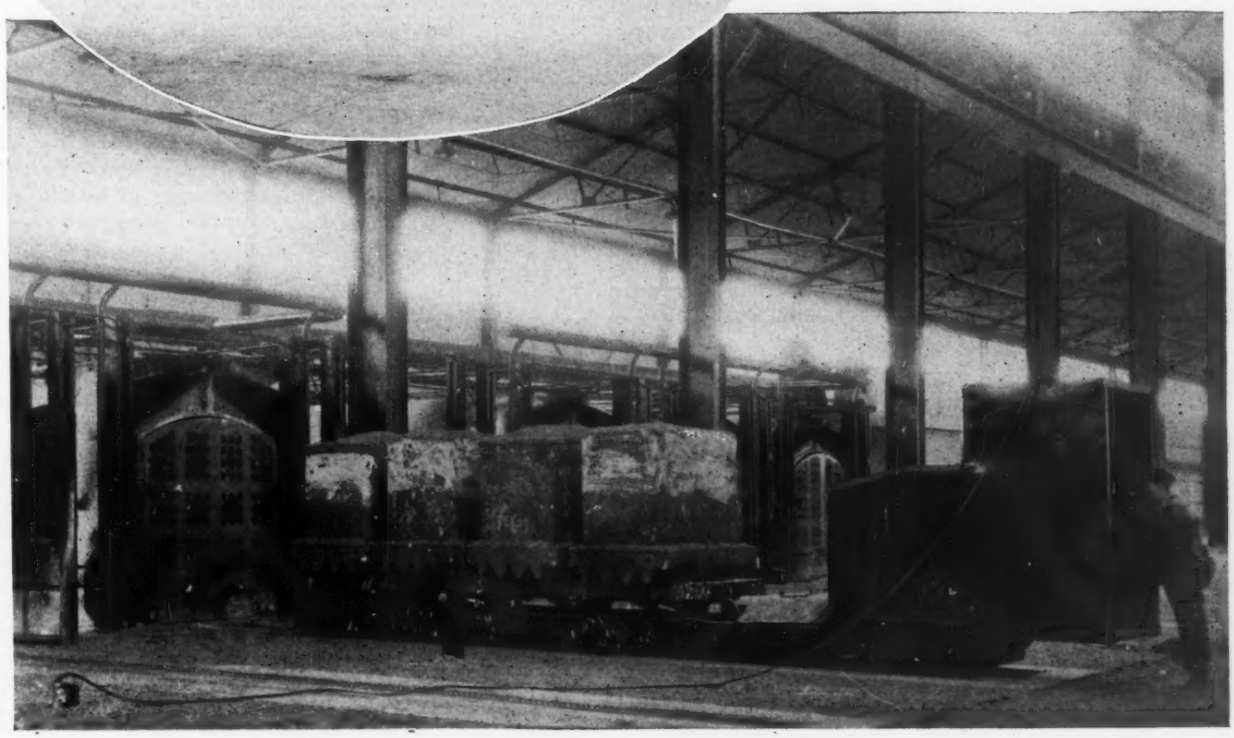




Above—The hot rolls are driven by 1,800-hp. Westinghouse motors

Left—Tinning department, with a "Branner," or polishing machine, in the foreground

Below—The cleaned sheets are delivered to an annealing furnace by a portable charger that is lifted from track to track by an overhead crane



THE SCOPE FOR *Reverse Classification*

THE author of this article, who is on the faculty of the department of mining engineering of the University of Toronto, describes observations of and deductions from a series of tests. He summarizes his studies by stating (a) that with a sufficient degree of horizontal agitation a layer of particles of different sizes but of the same specific gravity will arrange itself with the larger particles above and the smaller particles below; (b) that, considering any one material, the particles of greatest inertia will tend to move in the direction of the place of least motion; (c) that, if the particles are of different size and different specific gravity, those of the greater specific gravity will be graded in size in the bottom layer, and those of lower specific gravity will be graded in size in the upper layer; (d) that the larger particles of the material of greater specific gravity will associate with the smaller particles of the material of lower specific gravity. He concludes that a combination process, comprising water current classification and crowded settling classification, is an efficient method for the separation of particles of different sizes and different specific gravity.

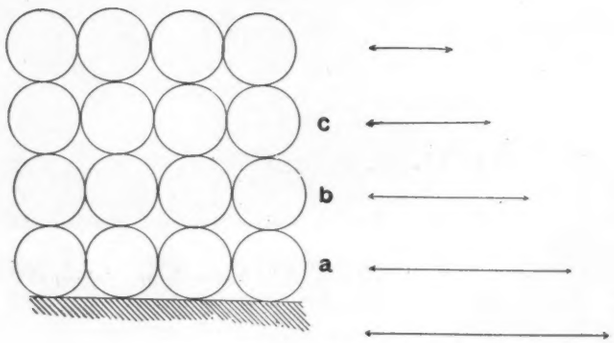


Fig. 1

HYDRAULIC CLASSIFICATION of mineral particles is commonly performed under conditions to which have been given the names free settling and hindered settling. In hydraulic classification the particles are separated by currents of water operating against gravity. The particles themselves are sufficiently far apart not to interfere with each other; hence the term *free* settling. If the upward velocity of the current be sufficiently reduced, the particles will still classify, but under conditions where the particles jostle each other. Part of the upward energy of the water is used in causing horizontal agitation. This condition is *hindered* settling.

If the upward velocity be reduced to zero while horizontal agitation is impressed in sufficient degree, classification will still take place. Under this condition the particles will be as crowded together as is consistent with the particles changing their relative positions. Classification under these conditions may be termed *classification by crowded settling.* Because no upward velocity is required to give buoyancy to the particles, an upward current of water is not necessary, and water may be eliminated, the necessary horizontal agitation being given by mechanical means.

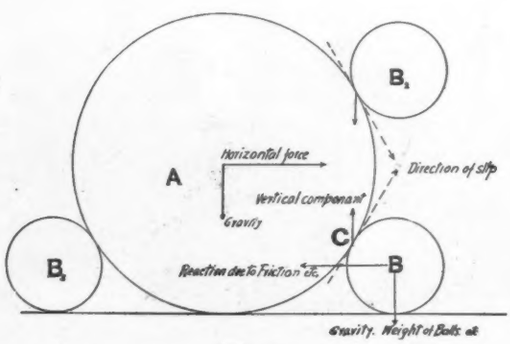


Fig. 2

Horizontal agitation may be applied to a mass of particles by mechanical means in several ways.

Let us consider one of the simplest—that of a mass of particles supported by an oscillating plane surface, such as is well known in the Wilfley table, but without causing progression. It is essential that there be sufficient friction between the plane surface and the particles, and between the particles themselves, to cause the motion of the plane surface to be transmitted from the surface to the particles and from one particle to another, and yet there must not be so much friction as to prevent

By FREDERICK C. DYER

BY *Crowded Settling* in Ore-Dressing Practice

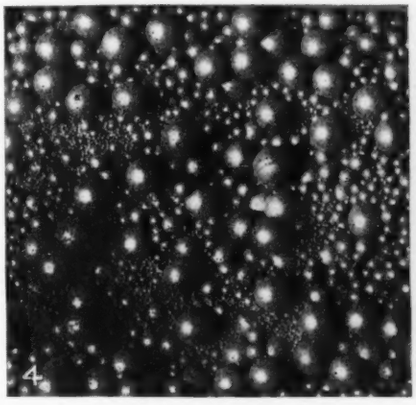


Fig. 4—Original mixture

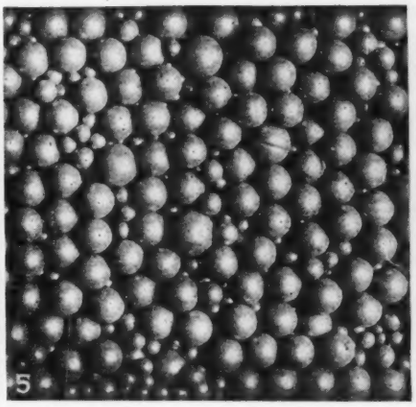


Fig. 5—Top of mass after agitation

Fig. 6—Bottom of mass after agitation

How a mixture of balls behaves on agitation

one particle slipping over another; otherwise classification would be impossible.

In a bed of particles as in Fig. 1 the motion of the plane surface will be transmitted in part to the lower layer (a) of particles. This layer of particles will in part transmit the motion to a layer above (b), and this layer in turn will transmit part of its motion to the layer above (c), and so on until the motion transmitted in decreasing amounts becomes negligible. If the bed is very deep the lower particles may be held down by the weight of the upper layers so that there can be no slip. Therefore, classification by crowded settling can take place only in beds of particles sufficiently shallow to allow of slip between each layer of particles. Without slip, classification would be impossible.

When the agitation is sufficient to cause slip, the compactness of the mass of particles is necessarily lessened, allowing particles, if sufficiently small, to pass through the interstices between larger particles, and to sift downward. As a result of this screening action the smaller particles will tend to accumulate in a layer at the bottom of the bed. If screening were the only operation taking place, the lowest layers would consist of larger balls with their interstices occupied by much smaller balls. Observation and theory show that this is not so.

In a bed of particles consisting of particles of various sizes, downward sifting is not the only change that will take place. A true classification takes place, in that not only do smaller particles sift downward, but larger particles are forced upward.

It is easy to understand that if the large particle is much larger than a smaller one it may ride over it in the same way that a wheel rides over a stone in the road. This action may take place, however, with horizontal agitation if there is any difference between particle sizes if the particles are crowded together.

Referring to Fig. 2, A represents a large particle at the bottom of the bed and B, B_2 and B_3 represent smaller particles surrounding and in contact with the larger particle. These again will be surrounded by other particles. When the plane surface moves, friction transmits some of the motion to the particles, but in less degree because of the inertia of the particles causing slip. With a slowing up of the motion of the surface, the particles will tend to keep moving, as a result of their momentum. The small particle B cannot slip away from its position against A, because of friction and the opposition of the surrounding particles; therefore, the large particle A will tend, because of its larger diameter and consequently greater momentum, to ride over the smaller. Some of its horizontal energy (either of inertia

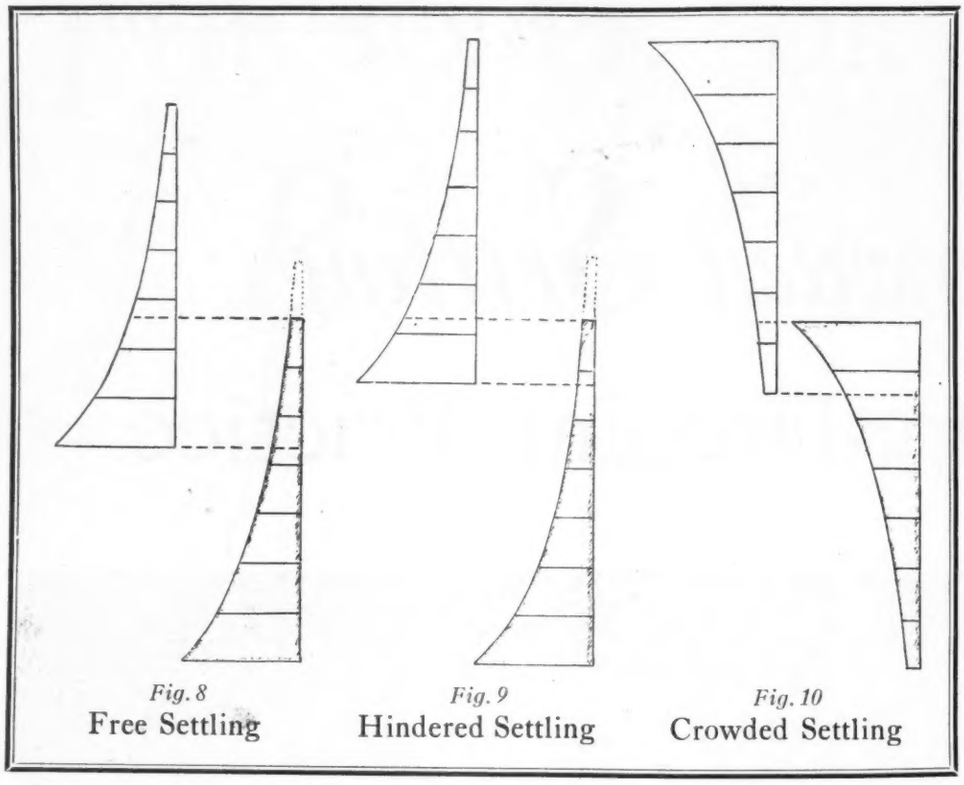


Fig. 8 Free Settling

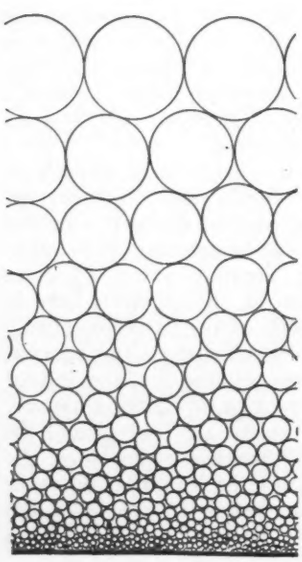
Fig. 9 Hindered Settling

Fig. 10 Crowded Settling

or momentum) is converted to a vertical component at the point of contact C. Similarly, at each contact of A and B, B_2, B_3, and so on, there is a vertical component, some components upward and some downward. Because of the progressive looseness of the bed of particles toward the top, the downward components of the upper small particles will be less than the upward components of the lower particles, the resultant of them all being a tendency to force the larger particle upward and the smaller particle downward.

The theoretical final arrangement will be a graded arrangement of particles from the largest at the top to the smallest at the bottom, as in Fig. 3. Fig. 4 is a photograph of a mixed mass of steel balls ranging from 1 inch downward to $\frac{1}{8}$ inch before agitation. Fig. 5 is the top of the mass and Fig. 6 the bottom of the same mass of balls after agitation.

Fig. 3



Irregularly shaped particles such as crushed rock will behave in the final resultant the same way as do balls. Flat particles may not classify in the same way, because of the absence of sloping contacts on which the particles may slide. A wheel may ride over a block by a partial revolution, but it is not necessary that a particle revolve provided it can slip at the point of contact.

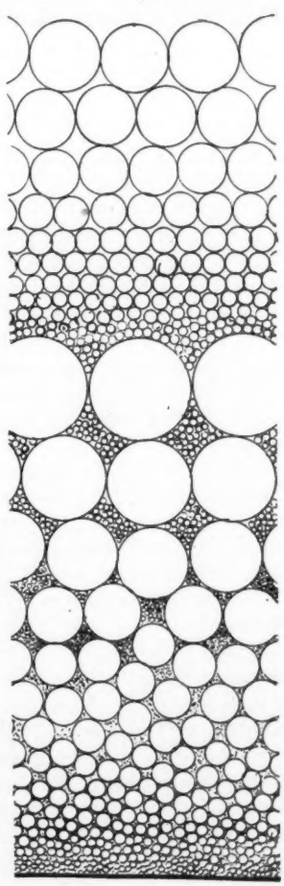
If the degree of agitation be insufficient, the resultant upward force may not be great enough to raise the larger particle through the superincumbent mass; whereas, if the degree of agitation is too great, the bed of particles may be so loose that the small particles are pushed aside and the larger particle will sink. Under these conditions classification will be incomplete.

The violence of horizontal agitation required to produce classification by crowded settling is controlled by the masses of the individual particles. Agitation sufficient for the larger ones may be too much for the smaller, so that for good classification there is an upper limit and a lower limit to the size of particles in a bed that can be classified by a given degree of agitation.

The presence of water, by reducing the apparent mass of the larger particles, will render them more easily raised. With the smaller particles the decreased apparent mass may make them more easily pushed aside; so that in a wet pulp less agitation may be required, and at the same time the smaller particles may require to be removed.

If in the bed there are two sets of particles of differing specific gravity subjected to horizontal agitation, each group will tend to arrange itself in order with the larger particle at the top and the smaller at the bottom. Particles of greater specific gravity will find their way to the lower part of the bed. Lighter material will arrange itself with the finest particles at the bottom, occupying, if sufficiently small, the interstices of the lower heavier layer, and, above that, arranging its particles in order of increasing size toward the upper part of the bed. The arrangement will be as indicated in Fig. 7. Thus we have a classification both as to size and as to specific gravity. Figs. 11 and 12 show this re-

Fig. 7



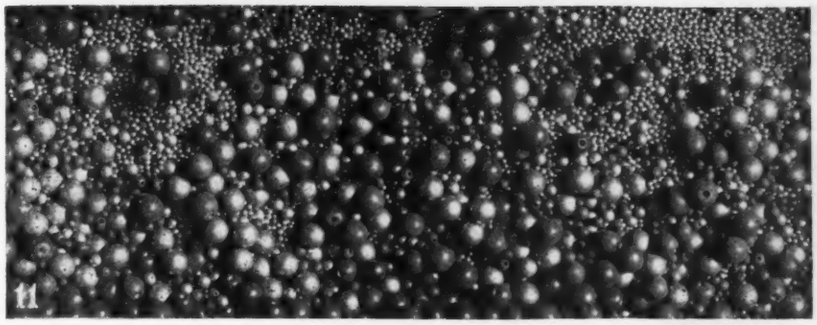


Fig. 11

A mixture of steel and wooden balls of various sizes, before agitation. The wooden balls are bored, to distinguish them from the metal balls.

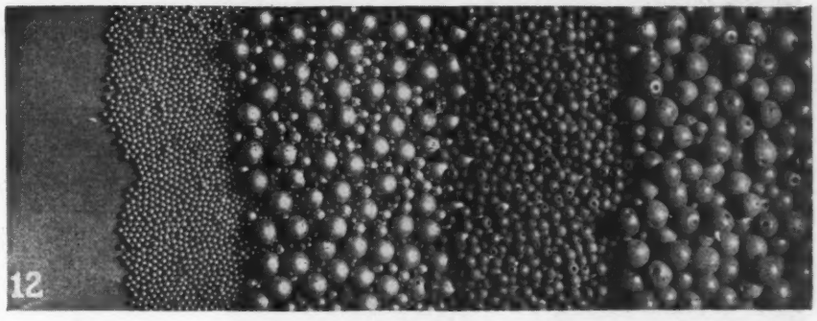


Fig. 12

The same mixture after agitation. Layers of homogeneous material have been carefully picked off to disclose what lies underneath.

versed classification in a layer of balls. The mixture consists of wooden balls and steel balls of several sizes. Fig. 11 shows the mixture before agitation. Fig. 12 shows the classification after agitation. The layers in turn have been picked off without disturbing the lower layers. Darker layers are wooden balls; and the brighter ones are steel. The small wooden balls between the interstices of the large steel balls may be identified by the holes in them.

Comparing the diagrams of association ratios in Figs. 7 and 10 of crowded settling classification with Fig. 8 of free settling classification, and with Fig. 9 of hindered settling classification, this difference will be noticed: whereas with free settling and hindered settling classification the larger particles of light material are associated with the smaller particles of heavier material, with classification by crowded settling it is the larger particles of heavier material that are associated with the smaller particles of lighter material. The classification is *reversed*.

Unlike classification by free settling and hindered settling, which give approximately definite ratios to the diameters of consorting particles, in reversed classification by crowded settling there is no definite settling ratio, the diameters of consorting particles being dependent on the sizes and numbers of the particles of the two substances. The settling ratio is not a constant.

Classification completed, it remains only to move the layers in different directions to make a separation.

Because for classification by crowded settling it is necessary that the particles be in contact, the two layers must also be in contact and there may be a mechanical difficulty in separating the two layers completely, giving rise to a middling in addition to the two clean layers.

If, as is frequently the condition in mineral separations, the particles of the lighter material are small enough to go into the interstices of the lower layer, then, though the top layer may be clean, the bottom layer will contain a middling. The middlings arising from both of these causes, however, are composed of particles of sizes that are the most widely separated by either free settling or hindered settling classification. Consequently, a combination process comprising a water current classification and a classification by crowded settling is ideal for the separation of particles of differing size and specific gravity.

Reversed classification by crowded settling may be summed up as follows:

1. With a sufficient degree of horizontal agitation a layer of particles of varied sizes and the same specific gravity will arrange itself with the larger particles above and the smaller below.
2. Considering any one material, the particles of greatest inertia will tend to go to the place of least motion.
3. If there are particles of varied sizes and differing specific gravities, the one of greater specific gravity will be graded in size in the bottom layer and the one of lighter specific gravity will be graded in size in the upper layer.
4. The larger particles of the material of greater specific gravity will associate with the smaller particles of the material of less specific gravity.

U. V. X. Copper Costs 7½c. to Produce

ACCORDING to the annual report of the United Verde Extension Mining Company its 1928 production of 45,200,041 lb. of copper was attained at an average cost of 7.5c. per pound. The distribution of costs was as follows:

Distribution	Per Pound Cents
Mining	0.0267
Smelting	0.0270
Freight on ore	0.0009
Freight on bullion, refining and selling	0.0182
Other expenses	0.0022
Total	0.075

Charges for depreciation, depletion, or taxes, are not included in the above figures.

Australian Mining Enters New Era

Development of Mount Isa Property Along Economical and Efficient Lines Will Point the Way for Other Opportunities to Exploit Low-Grade Ore in the Antipodes and Hasten a Return to Mining Prosperity. An Interview in New York City With

Mr. Leslie Urquhart, Chairman of the Board of Russo-Asiatic Consolidated, Ltd., and Mining Trust, Ltd.

A VISITOR TO THIS OFFICE recently made the remark that he thought little of Mount Isa's prospects because the mine was low-grade. Such a comment reflects the attitude of a passing generation of mining engineers, most of whom, throughout their careers, have remained detached from the operating achievements in mining and metallurgy that have made the low-grade mine the focal point for brilliant technical achievement, in many instances raising it to the pinnacle of importance as the lowest-cost producer.

This new philosophy of mining enterprise instills a spirit of courage and initiative, to face obstacles and to solve them, that was absent in the old days when a mine was judged by the superlativeness of its assays, and little attention was paid to the size of the orebody or to the possibility of a revolution in mining and metallurgical methods that would serve to transform that borderland material we have called junore into a reserve of commercial value.

An outstanding figure in the penetration of British capital and organizing ability in the mining world, Mr. Leslie Urquhart recently passed through New York on his way to the Mount Isa mine, in Queensland. Few moments elapsed in conversation with him before the fact was plainly evident that he is an engineer-explorer and administrator of the new type, fully cognizant of and keenly interested in the new tools available for the fashioning of a prosperity for the mining industry by the utilization of all that is progressive and modern in methods and equipment.

The earlier career of Mr. Urquhart, especially in regard to the operations of Russo-Asiatic Consolidated, as Chairman of that vast undertaking, is well known. A biographical sketch was published in *Engineering and Mining Journal* of Sept. 22, 1923, after war and revolution had put an end to one of the most constructive steps taken in the support of the non-ferrous metal industry of the Russian empire. A claim of £56,000,000 by the company against the Soviet government as indemnity for the confiscation of property and assets awaits recognition; but Mr. Urquhart was not

Map of Australia, showing location of Mount Isa

content to abandon active participation in mining affairs and wait for a settlement of the obligation. If Russia chose to be unreasonable, opportunities elsewhere awaited the touch of engineering genius, adequate capital, and technical skill.

The mining industry of Australia was languishing, for various reasons, one of which was the high cost of small production. Mr. Urquhart became interested in the Mount Isa property, in Queensland, and decided that it was a fitting object for attention and for the application of those new methods of mining and metallurgy that have been shown, in the recent history of the copper industry, to be the most powerful factors in the attainment of technical efficiency and economic success. If the margin of profit appears small under such conditions, the tonnage is great, and there is no end to the outcome of a scientific inquisitiveness that seeks the ever-changing ideal of lower costs and engineering efficiency.

The Mining Trust, a new company formed by Mr. Urquhart, therefore absorbed the Mount Isa property, utilizing the available assets of Russo-Asiatic for the purpose of acquisition and development. A great zinc-lead-silver orebody is being opened up not far from Townsville, in Queensland, indicating large reserves and the prospect for the ultimate development of a mine of immense ore resources. The railroad connecting the mine with Townsville is completed. Modern community buildings—an innovation in Australian mining company practice—are being erected. The latest in housing, sanitation, and recreation is being provided. Labor is plentiful, and a new era of industrial relations is promised, thereby removing one of the main obstacles to success. Pilot-plant investigation has resulted in the development of a satisfactory metallurgical scheme, and a start has been made in the construction of the first 2,000-ton milling unit. The most modern mining methods are being adopted, based to a considerable extent on the successful development and the economical production of large tonnages of ore in the United States.

Mining Trust, in addition to its control of Mount Isa, has an interest in properties in France and New Guinea. It also owns a prospecting concession of 10,000 square miles that may prove to be a continuation of the Northern Rhodesian copper field, in which keen interest is being evinced.

A feature of Mining Trust is the availability of a technical committee consisting of gentlemen of international standing as mining engineers and specialists. This committee, under the chairmanship of Mr. Urquhart, includes D. P. Mitchell and R. Gilman Brown, consultants; J. M. Callow, president of the General Engineering Company; H. H. Knox, of Knox & Allen, consultants, of New York; and Charles A. Mitke, an authority on mining methods and a frequent contributor to *Engineering and Mining Journal.*

Under such expert direction, and assured of adequate capital, the Mount Isa enterprise promises to provide a new start for the Australian mining industry. Nearly £1,500,000 of British capital has been invested there, and the confidence thus shown by Mr. Urquhart and his associates in the integrity of the Queensland Government should engender a spirit of co-operation in official quarters that will do much to smooth the way to the attainment of a success that will have a powerful effect in stimulating other ventures of the same character, in reducing unemployment, and raising the standard of living. Australia may look forward with confidence to reaping the reward of satisfactory relations between Labor and Capital if the Mount Isa development is given an opportunity to expand and prosper.

Typical mining scene in Queensland

Ingress of Solutions Into Ores During Leaching Studied

AN INTENSIVE STUDY of the leaching of coarse material to determine fundamental characteristics of behavior that are applicable to any mineral-bearing ore is being conducted by the U. S. Bureau of Mines, at the Southwest Experiment Station, Tucson, Ariz., in co-operation with the department of mining and metallurgy of the University of Arizona. These data are expected to be useful in the development of economically feasible methods for recovering copper from the low-grade disseminated ores of the Southwest.

Four factors are essential to the successful leaching of any copper-bearing ore, state John D. Sullivan, Walter E. Keck, and George L. Oldright, in a report just issued by the U. S. Bureau of Mines. These factors are: (1) A solution that will attack the copper minerals must get into the body of the ore particles; (2) the copper minerals must be dissolved by chemical action of that solution; (3) the solution containing the dissolved copper must find its way out of the voids of the rock into the main solution; and (4) the copper in solution must be recovered by some means of precipitation. The first step, penetration of the leaching medium into the body of the ore particles, is discussed in the report just published. Succeeding reports will present the results of research on other phases of the problem.

The ores studied with regard to the ingress of solutions during leaching are typical porphyry ores of the Southwest containing disseminated copper in both oxidized and sulphide condition. The report, designated as Technical Paper 441, presents data on the rate and volume of ingress of solutions into certain ores, on the application of principles of capillarity to the penetration of rocks by liquids, and on the manner of penetration. Before this work was undertaken it seemed probable that certain laws of physical behavior governed the rate of penetration, including the law of capillary rise and Poisseule's law for the flow of liquids through orifices. Evidence, however, has been offered to show that the solubility of the gas within the rocks in the penetrating liquid is the factor that determines the rate of ingress of solutions.

From the various properties affecting the rate of ingress of solutions, rocks for leaching may be classified as follows: (1) Ore of the "shell" type, in which solutions penetrate more or less uniformly; (2) ore in which solutions penetrate along fractures or cleavage planes to main channels and then from these larger openings penetrate through smaller openings and pores, the rock itself weathering very little; and (3) rocks that break down in weathering.

This study has been limited to pieces up to 6 in. in size, so that when it is considered that boulders up to 6 ft. in size are often found on heaps it can be seen that penetration may be a very slow process in lumps of the larger size. From the practical side this suggests the possible advisability of finer crushing of the ore before it is put on the heaps. Material could be crushed to minus 6 in. for a few cents per ton, and whereas it now takes ten years or longer to remove the copper from a dump with crushing to 6 in., this time could be materially lessened.

Another method of obtaining smaller pieces of ore is to blast directly to the desired size. It would not cost over 5c. per ton more to break practically all of the ore to 6-in. pieces than it now costs to break to the sizes usually obtained in open-pit mining; in fact, this 5c. would not be entirely added cost, as some saving would result because the steam shovel could handle all of the smaller pieces. The interest on the money from the extra copper extracted in the shortened time would amply pay crushing or blasting costs.

If it is desired to speed up heap leaching without finer crushing, it seems possible that this might be done by utilizing waste smelter gases or by running a roaster in conjunction with a heap-leaching plant. If waste gases are allowed to enter heaps and displace the air present before water is added to a given section of the heap, the solutions should penetrate more rapidly into the interior of the rocks. Also, waste gases would help to dissolve the copper minerals present.

Another plan is to remove the air out of solutions before they are added to the ore. If the air is removed by boiling or vacuum, the solution is starved in air, and consequently will more rapidly take up that in the voids. It has been shown that the rate of penetration is faster when the temperature is low. Putting on cold solution at night should therefore accelerate the penetration rate.

Boiling the air out of a solution before it is put on the heap might have a deleterious effect on the leaching operation itself, because the presence of oxygen aids in the chemical dissolution of sulphide minerals. In heap leaching, however, as air circulates up through the dump, the solution would soon become saturated with air or any other gas admitted at the bottom. Removing the air by boiling or vacuum would probably be too expensive to be practical, but it does fit in with the experimental results on speeding up the ingress of solutions into rocks.

There is surprisingly little difference in the rate of penetration of the various kinds of solutions into rocks; 5 per cent copper sulphate, 2 per cent sulphuric acid, 2 per cent copper sulphate or ferrous sulphate plus sulphuric acid, ferric sulphate, and distilled water have very nearly the same rates of penetration.

With the rocks studied so far it has been found that the solution enters along fractures and cleavage planes; from these larger fractures it gradually seeps into the rest of the rock. The first 50 to 75 per cent of the total penetration takes place very rapidly along these crevices and fractures, and the smaller voids are then filled more slowly from these points of initial penetration. This explains why only about 50 per cent more time is needed to saturate a 6-in. piece than a 1-in. piece.

The work on the rise of solutions up a tube filled with crushed ore by capillarity has brough out the fact that there is a definite relationship between the rate of rise in the column to the percentage of apparent total penetration in larger pieces of the same ore. In this connection it is interesting to note that whereas the changing of the surface tension of the liquid ascending by capillarity markedly affects the rate of rise, a change in surface tension has no appreciable effect on the rate of ingress of solutions into larger pieces.

Turkey Extending Railroads to Develop Chrome Resources

By Dr. H. von Engelmann
Constantinople, Turkey

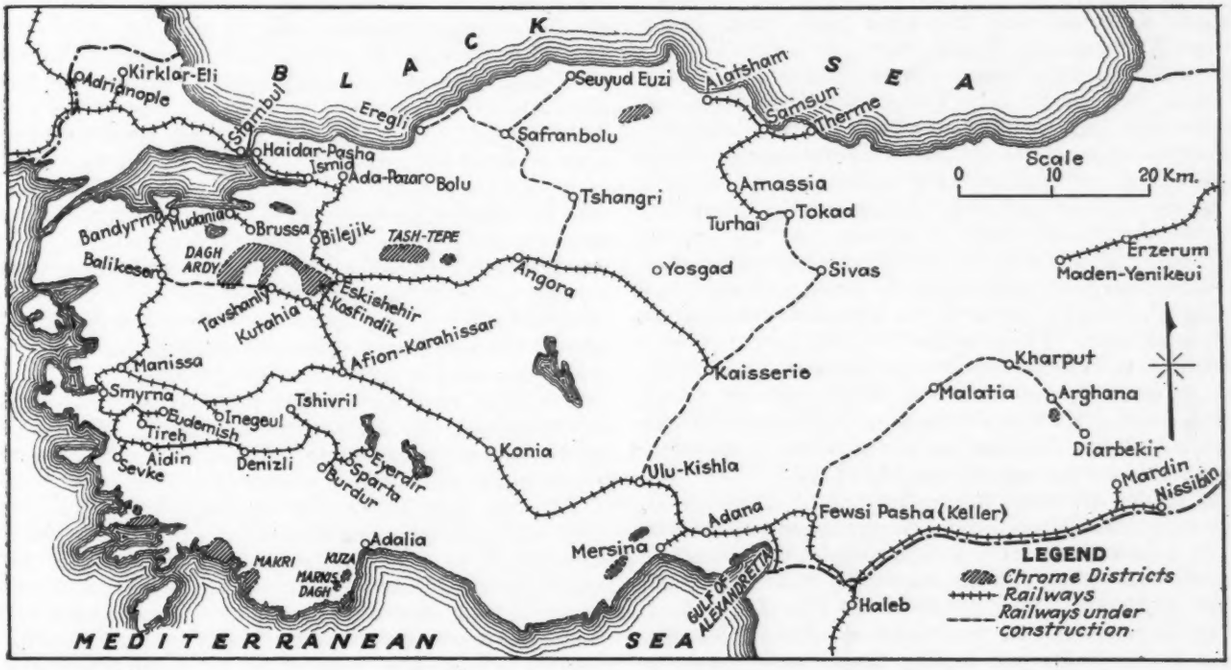
PROGRESS of metallurgical and chemical science, and naturally, also, of industry, gives the accessory metals, such as, nickel, cobalt, bismuth, manganese, and chrome, an ever-increasing importance. This is especially true of chrome. World demand for this metal since pre-war times increased more than a hundred per cent by 1921, and has continued increasing since that year. Principal consumers are the metal industries, chemical works, tanneries, and potteries. Quality of the ore varies with requirements of consumers. Steel works require 45 per cent of oxide of chrome with a limited percentage of iron; chemical works, 50 per cent chrome regardless of the amount of iron contained, and for potteries, likewise, less rich qualities of ore are admissible.

Manifold are consumers and their requirements, although the amount of chrome available is restricted. Before the war Asia Minor ranked third in the world for the production of chrome ore, nearly 29,000 tons being produced annually. Anatolian chrome was at that time renowned for its good quality. The most important producer of chrome was New Caledonia and the next was Rhodesia. The war and the years which followed greatly affected these well-known sources of chrome. Great Britain, wishing to secure a sort of monopoly, intensified chrome mining in Rhodesia. As a result, Rhodesian mines produced about 210,000 tons, or two-thirds of the world's supply. New Caledonia contributed about 50,000 tons, whereas the production of Asia Minor was, until recently, of no importance.

The largest consumer of chrome is the United States, which uses about two-thirds of the world's supply; this demand, moreover, is leading to a rapidly increasing production. Chrome production of the United States—about 80,000 tons during the last year of the war—having decreased markedly, brought about a dependence on foreign imported ore. In order to be free from the British monopoly, American works are gradaully beginning to engage in chrome mining operations. The Bethlehem Steel Company obtains 40,000 tons of chrome per year from its mines in Cuba; American capital is also invested in Caledonion and Greek chrome mines, and has secured mining claims in Brazil, without, however, reaching the importance of the predominant British market.

In the present situation chrome ore is in universal demand, and, therefore, production of chrome in Anatolia may regain its former importance. In fact, an international competition for Anatolian chrome ore prevails, and mines with good transportation facilities are arousing considerable interest.

Probably the most valuable mines are those of Keshish Dagh, near the newly constructed railway line between



Sketch map showing chrome deposits in Asia Minor

Kutahia and Tavshanly; of this group the best known are the mines of Dagh Ardy, which are about to be opened. Although the estimate of 400,000 tons made by some prospectors seems excessive, these mines undoubtedly contain large deposits of superior quality ore, averaging about 50 to 52 per cent. Exploited by the German firm of Roechling, of Saarbrucken, these properties now supply yearly about 14,000 tons. Adjoining mines of Kozludja and Karlijer, formerly Krupp concessions, were exploited during the war by the German military mission, and since that time have not been worked. Recently these mines were also taken over by the Roechling firm; and about 7,000 tons of ore stored there since the end of the war will be shipped.

The ore found near Adalia is also remarkable in quality, containing 50 per cent or more chrome. An important region lies south of that town. Here is the district of Ala Tshesme, comprising three mines: Tatas Bunar, Ala Tshesme, and Tshoplu Tepe; the district of Markis, Dagh, with four mines: two near Kutshuk-Tsham Kurtaran, and one mine each near Bujuk-Tsham-Kurtaran and Hemar Dere. At Teken Ova are the following ten mines: Janar Dagh, Buntshuklu, Sandali, Add Buku, Tekir Ova, Buku, Beydjik, Karga Janik, Utsh Tepe, and Tsheshu; and at Kuza is another mine. These comprise altogether eighteen mines in this region, none of which is being exploited.

Between Adalia and Alaja, on the way to Mersina, is another district abundant in chrome. In this region, inclosed by the mountain of Shimshirli Tepe, the village of Kara Burun, the river Bugusik Tshai, and the village of Sasagh Ini, are sixteen mines, most of which contain high-grade ore. These properties also have not been exploited, and each requires preliminary prospecting. The situation in the district of Makri west of Adalia is different. This region is held as a concession by the French "Société Minière de Fethié," which is selling from its mines the well-known Makri ore.

At present the most interesting part of Anatolia, so far as chrome is concerned, is the region near Eskishehir. In all, twelve mines were found, some in the immediate vicinity and others at the mountain Tash Tepe and south of Brussa. The grade of the ore ranges from 43 to 50 per cent. In this region the United Swedish Steel Works holds two mining claims and intends to exploit four other mines. This company is first systematically prospecting the mines near Eskishehir, Kosfindik, and Edrenos. Results obtained reveal considerable quantities of ore close to the surface that can be reached by simple extraction methods. Attracted by the results this Swedish firm obtained, the aforesaid German firm of Roechling also began exploring in the same region, and has obtained control of areas encircling those being developed by the United Swedish Steel Works. In turn, the last-named company is becoming interested in the Roechling sphere of operations near the Keshish Dagh mountain. Third, a French group is also showing interest in the mines of the district of Eskishehir. The mines further north in the district of Bosular, Vilayet of Brussa, and the mine near the village of Kaslik, which were ceded to the Turkish Mining Company, have also been acquired by the Roechling company. Competition in this central region is hence quite active.

In the district of Guleman are many mines containing 48 to 49 per cent ore. Until now exploiting them was impossible, owing to the lack of communications. As soon as the railway line between Fewsi Pasha (formerly known as Keller), Malatia, and Diarbekir, now under construction, is completed, they will undoubtedy receive increasing attention.

Naturally, the most important factor in the development of Turkey's chrome resources is that of transportation. As soon as the 3,000-mile railway system planned by the Angora government is completed, the exploitation of Anatolia's many natural resources should proceed rapidly.

Distribution of Arsenic Studied in Connection With Michigan Copper Deposits

T. M. BRODERICK of the Calumet & Hecla geological department, recently made a re-study of the subject of zoning in Michigan copper deposits, and in this connection considered again the distribution of arsenic. In a summary of his investigations, Mr. Broderick states that arsenic occurs in small quantities in all the known copper deposits; that in most mines its ratio to copper increases in depth; that generally the higher the arsenic ratio, the higher the rate of increase; and that on the Baltic lode mines—the lowest stratigraphically of any included in the study—the arsenic ratio increases with depth up to more than 0.5 per cent, and then gradually declines with greater depth. Consequently, a continuous arsenic ratio-depth curve can be constructed from known data with interpolations. Such a curve indicates that the known deposits of native copper may extend over a range of more than 20,000 ft. measured up the dip along the lodes. A variation of this sort, if it be a function of distance from a source of mineralizing solutions, constitutes what is commonly called zoning.

An arsenic ratio curve, which probably portrays actual conditions, has been constructed, showing a point of maximum arsenic deposition. Similarly, curves showing mineralogical and chemical features might be constructed if sufficient quantitative data were available. Each of these would probably resemble the arsenic curve in showing a point of maximum deposition or reaction. Of prime importance would be the ability to construct a copper curve with its characteristics of rise, maximum and decline. These curves would probably bear a fixed relationship to each other. Above all, to be able to say that the range of commercial copper deposition had a given distance relationship to some easily determinable feature would be desirable. This is not yet possible, however, as little is known concerning the copper curve except that, so far as the arsenic curve is reliable, commercial deposits do occur over a range of probably 20,000 ft. and more along the lodes. The maximum copper deposition may be outside the region included in the known orebodies.

Copper Range mines in the Baltic lode are advancing the knowledge of the mineral zones because they are at present in deeper zones than any of the other mines. Indications are that they are on the declining side of the arsenic ratio curve, but this is not known definitely.

However, says Mr. Broderick, this study apparently indicates that mines operating on commerical lodes having characteristics of the higher zones could not lose their copper suddenly because they run into the bottom of the zone of copper deposition. Conceivably, certain structural features can cause the ore to become lower grade or even non-commercial at relatively shallow depths in such mines, but copper deposition probably continued for long distances below the present bottoms of the mines of the upper zones.

Leaching Manganese

From the Siliceous Iron Ores of Minnesota

By CARL ZAPFFE
Manager of Iron-Ore Properties,
Northern Pacific Railway Company, Brainerd, Minn.

History of the Development of the Bradley Process . . . The Fundamentals of the Method and the Technique of Application . . . Flow Sheet of Operations . . . Data as to Production Estimates

ABOUT TEN YEARS AGO I was asked this question: What can be done with the siliceous, manganiferous iron ores of the Cuyuna iron ore district of Minnesota? I replied that the only feasible way to treat them seemed to me to be in dissolving the manganese from the rock with the aid of a liquid and make a high-grade manganese concentrate from the solution. I had no definite idea how it would be accomplished, but the mineral composition of the formation clearly indicated that no method of beneficiation then in use could be applied successfully. One of the men present accepted the answer as a suggestion of merit and forthwith undertook experiments in lixiviation. After a few trials he discontinued the work, and soon thereafter Wilson Bradley, of Deerwood, Minn., in the Cuyuna district, an engineer graduated from Princeton University, who had been engaged in mineral land developments in the Cuyuna region, undertook this same problem. After devoting two years to preliminary study, Mr. Bradley associated himself with a few men of high standing, resulting in the formation of the Bradley-Fitch Syndicate, with the sole purpose of solving this special problem. In 1926 the Bradley-Fitch Syndicate was reorganized into the Bradley-Fitch Company, to finance a pilot plant in which the several findings made by Mr. Bradley could be tried out on an operating basis. The plant built and used had a four-ton daily capacity and included practically all the elements necessary for a large-scale operation.

Mr. Bradley had availed himself of associations with such men as Dr. Charles A. Doremus; Dr. E. P. Mathewson; the personnel of the chemical laboratory of John C. Wiarda & Company, in Brooklyn; the Dorr Company, at Westport, Conn.; N. Arthur Laury, of Brooklyn; and H. A. Brassert & Company, consulting engineers, of Chicago. A. J. Boynton, vice-president of the last-named company, devoted a great deal of time last year in investigating every step and every piece of apparatus Bradley offered as a component part of a system. He has given the Bradley process his unqualified approval as a practical process and a sound economic venture, and has prepared a design and plan for a plant of commercial scale.

Mr. Bradley has heretofore refrained from publishing anything about his work. One reason was that he started unbiased by any previous ideas, and his experimental work became, from time to time, of the nature of trying to disprove what he had found, and, again, prove that what others had found was unsuitable or impracticable. That led not only to a long period of experimentation; but with its conclusion Mr. Bradley makes it possible to present a thorough and complete job for inspection.

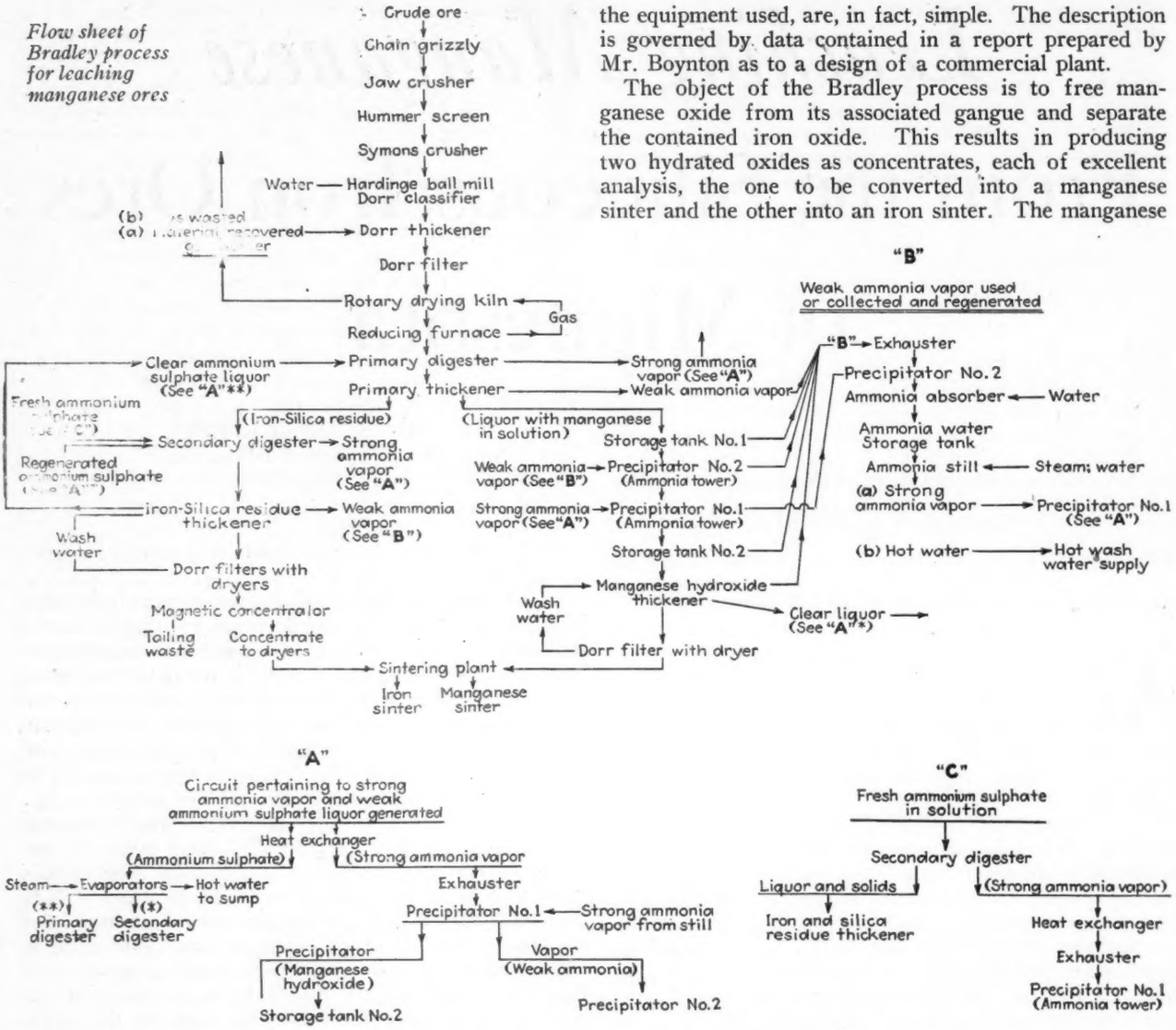
For the first time, we may present a complete account of the technical points involved. I have taken no part in the experimental work, but have had the good fortune to be able to witness and to discuss its progress. To be permitted by Mr. Bradley to write a technical description of his process, to which reference has been made so often and which has attracted so much attention, is a decided compliment. I intend to make this first exposition as complete as possible, to convince the reader of the thoroughness of the work and the soundness of the process.

EARLY WORK SHOWED SO_2 LEACHING POSSIBLE

Leaching manganese by using sulphur dioxide gas was shown possible many years ago. Bradley tried it for a year, working in conjunction with the original experimentor, of that method, and found that although relatively pure manganese oxide could be produced, the likelihood of developing a commercial process along this line was not encouraging. He also attempted leaching with nitric and sulphuric acids, but the cost of recovery mounted, and the quality of the product was not as good. Bradley gives much credit to Dr. Doremus for the many suggestions made during those preliminary tests, as a result of which Bradley tried nearly every leaching method proposed, and the experiments were made on a large scale in the spacious laboratories of the Wiarda Company. Insufficient encouragement was discernible in the results obtained.

Upon the suggestion by N. Arthur Laury, of John C. Wiarda & Company, Bradley undertook using ammonium sulphate. Because a high rate of recovery appeared feasible, Bradley planned the erection of a four-ton pilot plant at the State of Minnesota Mines Experiment Station, at Minneapolis.

Flow sheet of Bradley process for leaching manganese ores



the equipment used, are, in fact, simple. The description is governed by data contained in a report prepared by Mr. Boynton as to a design of a commercial plant.

The object of the Bradley process is to free manganese oxide from its associated gangue and separate the contained iron oxide. This results in producing two hydrated oxides as concentrates, each of excellent analysis, the one to be converted into a manganese sinter and the other into an iron sinter. The manganese sinter may be made to contain as high as 70 per cent manganese and as low as 1 per cent silica, with phosphorus not to exceed 0.02 per cent, and from that figure downward to about 0.005 per cent, and with sulphur at 0.007 per cent.

By trial and correction of errors, a complete flowsheet was established. The feasibility of each step was thoroughly demonstrated, and soon manganese recovery was around 92 per cent. Then the staff of H. A. Brassert & Company interested itself in the work and made an exhaustive study of the principles, processes, and apparatus involved. In a letter addressed to the Bradley-Fitch Company dated March 15, 1929, A. J. Boynton, vice-president, writes:

"Our study of the technology involved has extended over a period of a year or more, and has covered every feature of operation and equipment. We believe the process to be technically correct and practically controllable. The apparatus required is standard in the metallurgy of the higher metals, and is obtainable from firms of high commercial and engineering standing. We regard the process as experimental only with respect to adjustment of details of construction and operation.

"We recommend the process as an unusual opportunity for developing a highly profitable business."

The description that follows may give rise to the belief that the equipment needed is delicately balanced and that the process is involved. Such opinions can result only because of the efforts made herein to present a comprehensive description of a large number of features. All of the steps in the process, as well as

As a first step, the rock treated is crushed and ground to pass a 65-mesh screen, the size found most effective. This product is roasted in a reducing atmosphere, using blast-furnace gas, or partly burned water gas, or producer gas, at a temperature of about 750 deg. F. Thereby the MnO_2 in the rock is reduced to MnO and the Fe_2O_3 is reduced to Fe_3O_4, with a minimum of reduction to FeO. MnO and FeO are soluble and Fe_3O_4 is insoluble in ammonium sulphate in aqueous solution. This selective roasting is a discovery by Bradley, others having failed because of their use of higher temperatures.

The leaching reaction, which constitutes the next step, changes the oxide to a sulphate of manganese, with the evolution of ammonia gas, represented by this equation:

$$MnO + (NH_4)_2\,SO_4 = MnSO_4 + 2\,NH_3 + H_2O$$

At this stage of the process, the manganous sulphate is in solution. After clarifying the solution of any residual ore, and having captured the ammonia gas released in the reaction, the liquor and the gas are brought into contact in a standard ammonia tower and man-

ganous hydroxide is precipitated, according to this reaction:

$$MnSO_4 + 2\ NH_3 + 2\ H_2O = (NH_4)_2\ SO_4 + Mn(OH)_2$$

The manganous hydroxide is immediately treated with atmospheric air and changed to partly dehydrated manganic hydroxide, according to this reaction:

$$2\ Mn(OH)_2 + O = 2\ MnO.OH + H_2O$$

In this form the precipitate is stable and may be settled, washed, dried, and sintered. Application of atmospheric air in changing the unstable manganous hydroxide to a stable precipitate of manganic hydroxide was a point developed by Bradley.

The reversibility of the first two reactions makes it possible to re-use the ammonia. The losses are slight, and are attributable to possible leakages of the gas occasionally and to the ammonium sulphate which the moisture in the manganous hydroxide, before sintering, may have in solution. These losses are unimportant. The possibility of the continuous use of ammonium sulphate in a recurring cycle is a feature usually appearing doubtful to the uninformed, and it is the very feature which makes the process commercially feasible. Only a small addition of fresh solution of ammonium sulphate is made daily, to obtain better results in a single step, to be described later. The practical conditions under which the regenerative leaching and precipitating cycles operate constitute one of Bradley's basic discoveries.

The manganese hydroxide is washed and dried, and may be sintered according to standard practices. That completes the process as to manganese, and 92 per cent of the original manganese content is recovered, determined by the experiments in the pilot mill.

Such magnetic oxide of iron as is developed by the selective roasting does not dissolve in the ammonium sulphate solution, and, with the silica of the ore, remains as a residue. This iron-silica residue is withdrawn, is washed and dried, is treated in a magnetic concentrator, and the recovered product is then sintered, to form an iron-sinter as a byproduct. The recovery of the iron units is conservatively estimated at 70 per cent.

Selective Roasting Advantageous in Preventing Formation of FeO

Early in his work Bradley demonstrated the feasibility of reducing manganese dioxide (MnO_2) to manganous oxide (MnO) which may be acted upon by the leaching liquor, while at the same time reducing the contained iron to the magnetic oxide (Fe_3O_4), which is not soluble, thus avoiding the reduction of iron to ferrous oxide (FeO), which would be leached at the same time as manganous oxide. Although the iron so leached could be eliminated from the manganese product in the leaching-precipitating cycle, the advisability of preventing its formation at the outset, by selective roasting, is readily apparent. In addition, it makes possible and facilitates the recovery by magnetic concentration of a valuable byproduct (iron ore).

In the reduction of MnO_2 to MnO and of Fe_2O_3 to Fe_3O_4 heat is evolved, but in any further reduction of Fe_3O_4 to FeO heat is absorbed. Selective reduction is therefore in accordance with the general thermo-chemical law that those reactions which produce heat occur readily and at moderate temperatures; whereas those which absorb heat are produced with greater difficulty and at higher temperatures. Conformity with this law indicated that selective roasting is possible with manganese dioxide and ferric oxide. Furthermore, it explains the reason for the ability to carry on the selective roast at low temperatures only. At the higher temperatures heretofore employed, both exothermic and endothermic reactions occur, the latter by virtue of the ease with which the heat loss of the reaction is replaced from the gases, and the reaction temperature maintained. At the lower temperatures employed by Bradley, the tendency is toward exothermic reactions only.

Experience has shown that a considerable reduction of Fe_3O_4 to FeO is possible even at the lower temperature used by Bradley; however, it happens only after the reduction of MnO_2 to MnO is nearly complete. Reduction of the manganese, therefore, precedes that of iron to FeO, and the manganese actually protects the iron from reduction.

Leaching and Precipitating Cycle Patented

Mr. Bradley's second basic discovery relates to the practical conditions under which the regenerative leaching and precipitating cycle operates. The chemical reactions were described by Laury, and in general the cycle is protected by his patent, under which the Bradley-Fitch Company has the sole rights. This cycle is correct as to reactions, but was discovered by Bradley to be operative only in the presence of a large excess of ammonium sulphate solution. The proportions of ammonium sulphate, and of manganous sulphate, in the leach liquor at various points in the cycle form the subject of Bradley's patent claim.

Another important feature developed by Bradley in operating his pilot mill was to digest his ore in two stages, with the precipitator interdisposed between. The liquor withdrawn from the precipitator, which at this stage is richest in ammonium sulphate and leanest in manganese, flows to the second digester, where it meets the partly leached ore conveyed to it from the first or primary digester. In the second digester the leaching of the ore is completed, but the liquor is now only partly enriched with manganese and is, therefore, piped to the primary digester, where its further saturation with manganese is accomplished by working on untreated material. From the primary digester the liquor flows to the precipitator, and then the cycle begins anew. Manganese is accordingly precipitated at the point of maximum saturation, and the final leaching is accomplished at the stage of minimum manganese content of the liquor. From this point the washing and drying follows, and then the sintering.

(To be continued)

Uses of Ground Mica Discussed

Mica which is not suitable for use as sheet mica is classed as "scrap" mica, says the U. S. Bureau of Mines, in a recently issued publication. It is ground to a powder and used in the decorative trade in the manufacture of wall paper, fancy paint, ornamental tile, and concrete facing, and for other purposes; as a lubricant both dry, as for auto tires, and mixed with oil and greases; for axle grease; for annealing steel; as a dusting agent for rolled roofing; for the manufacture of Christmas-tree snow; as an insulator for pipe and boiler covering; fireproof paint; and in various other ways.

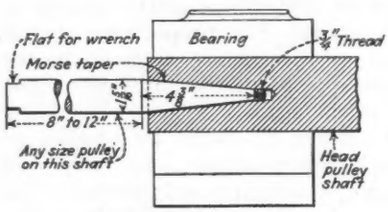
Mica used in the wall-paper trade is practically all ground to 160 mesh by the wet process. For the rubber industry, as for auto tires, it is ground by both the dry and wet processes to 100, 160, and 200 mesh.

USEFUL OPERATING IDEAS

A Satisfactory Extension Shaft for Belt Drives

By Charles Labbe

IN A WESTERN MILL treating custom ores, it was necessary to change the speed of the sampler drive for fine sandy ore as compared with the speed used for coarse ore. The most convenient drive for the sampler was constructed at the end of the shaft at the head pulley of the conveyor. A hole was drilled in the center of the shaft and reamed to fit a Morse taper, similar to that used in drill presses. To hold the shaft in place the end of the



An ingenious extension shaft

taper in the shaft was drilled deeper and tapped for ¾-in. thread.

The arrangement proved satisfactory; three short shafts were tapered and threaded at one end, the other end being designed for a pulley of the required size. The change can be made quickly, and when not in use the pulley, and shaft can be removed. Furthermore, the belt hook-up is simple and convenient for the three different sizes of pulleys; one is provided with a belt; and for any other pulley a piece of belting of suitable length is inserted, alligator belt lacing being used.

Current in Zinc Plant Regulated Automatically

THE cyclic variation of conductivity of the electrolyte, in the Tainton-process zinc plant at Kellogg, Idaho, taken in conjunction with periodic shutdown of electrical apparatus for cleaning, oiling, and brush attendance, made it imperative to adopt some means of obtaining constant kilowatt imput to the synchronous motors in order to maintain the desired load factor, states E. R. Fosdick in *Electrical World*. A new type of regulating equipment, believed to be the first of its type to be used for electrolytic zinc plant regulation, was furnished by the General Electric Company.

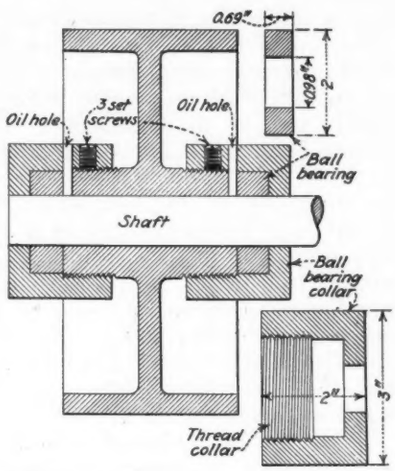
Current and potential transformers in the 2,300-volt power cables to the synchronous motors of the motor-generator sets have their secondaries connected to the control element, or contact-making wattmeter, of the automatic regulator, which is mounted on a control panel of the main switchboard. This control element through a timing device closes one of two pairs of contacts at regular intervals, or does not permit either of them to close, until some fluctuation in load causes a change in power taken by the synchronous motor. When a pair of contacts closes, it completes a circuit by means of an auxiliary contactor through the field-rheostat head, causing the driving motors to rotate the field rheostat brush arms. This regulates the field current and changes the generator load, either increasing or decreasing it as required to maintain constant the power taken by the synchronous motor.

Equipping a Cast Pulley With Ball Bearings

By R. N. Thomas

TO ELIMINATE rattle, noise, and friction a small high-speed pulley was equipped with ball bearings on each side of the hub. As the hub diameter was too small to have the ball race set into it by counterboring the hub, the following method was adopted:

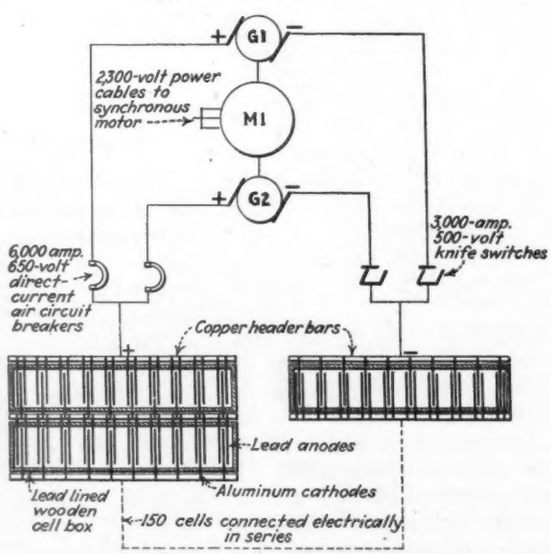
The outside diameter of the hub was turned down to 2.57 in., ten threads being cut on it per inch. The ball bearings used on this pulley were HB-DWF, and the 1-in. shaft was turned down to allow the ball race to be pressed on. These ball bearings were 2.441 in. in outside diameter, 0.984 in. in inside diameter and 0.67 in. thick. The collar to hold the race in place was made to



Cast pulley equipped with ball bearings

fit it at the bottom, allowing it to slide in the collar against the shoulder. The collar was threaded for the distance from the race to the end, fitting the threads on the hub. If the hub should be smaller than the outside diameter of the race, it should be turned down in a lathe sufficiently to fit. In shrinking the collar on the hub, allowance should be made to take care of the difference in the size of the hub and the inside diameter of the collar. The thread will be cut on this hub collar to fit the thread in the collar.

As the race will be pressed on the



Schematic diagram of electrolytic cells and supply circuit at Kellogg zinc plant

shaft, and the collar will be against the ball-bearing face, oil can be held in the center of the pulley, which will have about 0.004 in. clearance on the standard 1-in. bore pulley. Most pulley bores are larger than the standard, which will give more room for an oil film. The oil holes at each end should be located next to the ball bearing.

Curve Data Table for Standard Timbered Motor Drifts

CONSIDERABLE time is often saved by the mine engineering department in the use of curve data tables to determine the information necessary in changing the course of a drift to another course, writes H. S. Duncan, chief mine engineer, Old Dominion company. As an example, assume the present course to be North 26 deg. East, the new course to be North 70 deg. East, and the curve radius to be 50 ft. In this case the external angle "S" at the P.I. is 44 deg. On consulting the table reproduced herewith, it is found that along the 50-ft. radius line under "8 sets" the nearest angle "S" will be found to be 43 deg. 44 min., which is close enough for practical use. Under this angle is noted the external tangent of 20.06 ft. that applies to this case.

Thus it will be found by further inspection that eight sets will be necessary to complete the curve, that the long collar braces will be 4 ft. 2 in. long, and the short collar braces will be 3 ft. 8 11/16 in. long. Also that by using the diagonal distance 5 ft. 7 7/16 in. to position the sets, the results are quite satisfactory.

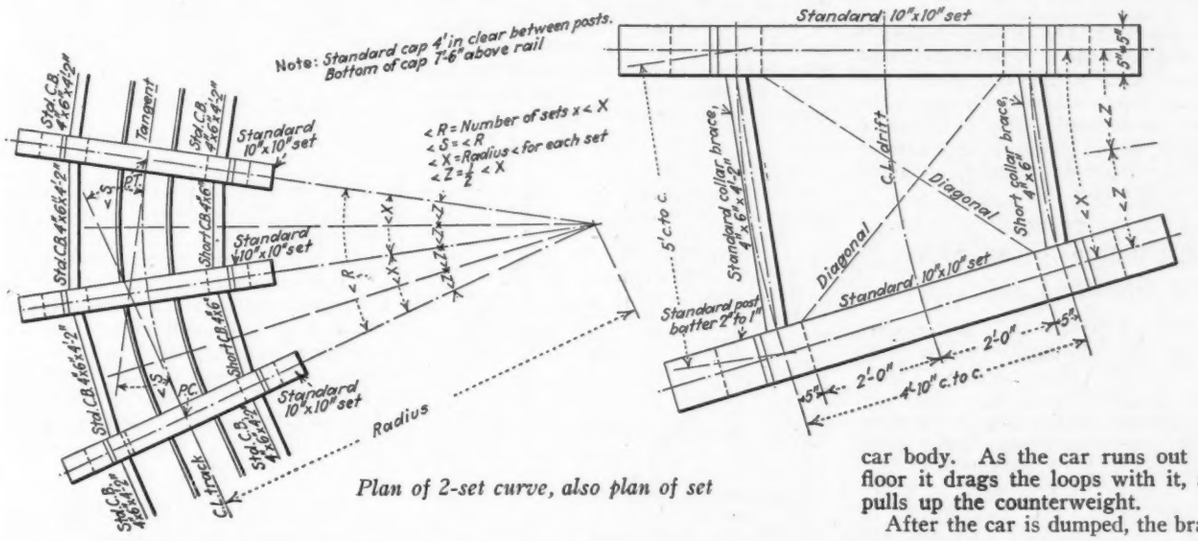
Returning Car to Incline

AT THE plant of the Lawrence Portland Cement Company, Thomaston, Me., is an unusual and satisfactory method of pulling a car back on the incline, described in a recent issue of *Rock Products*.

The car is brought up the incline by a hoist, which pulls it on to a floor above the primary crusher. After the car is dumped, two counterweights pull the car back, and it is the method of attaching and detaching these counterweights that is of interest.

The counterweights are attached to a cable that runs over a sheave and then to a double loop of steel, normally held in place by two short hooks catching in the lower loop as shown, when the car reaches the top of the incline it picks up the loops by two hooks fastened to the car body. As the car runs out on the floor it drags the loops with it, and so pulls up the counterweight.

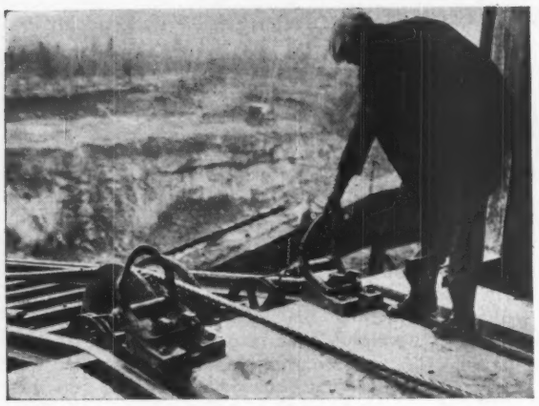
After the car is dumped, the brakes of



Plan of 2-set curve, also plan of set

Curve Data for Motor Drifts—4 ft. 0 in. Standard Cap

Rad.	Number of Sets													Collar Braces				Diag.	L-X	L-Z	Rad.
	1	2	3	4	5	6	7	8	9	10	11	12	13	Long	Short	Diff.	Cut				
12½′	19°18′ 2.12′	38°36′ 4.38′	57°54′ 6.92′	77°12′ 9.98′	96°30′ 14.01′									4′-2″	2′- 6½″	19¼″	11/16″	5′-2 1/16″	19°18′	9°39′	12½′
15′	16°30′ 2.18′	33°00′ 4.44′	49°30′ 6.92′	66°00′ 9.74′	82°30′ 13.16′	98°00′ 17.26′								4′-2″	2′- 8¼″	17¼″	11/16″	5′-3″	16°30′	8°15′	15′
17½′	14°26′ 2.22′	28°52′ 4.50′	43°18′ 6.95′	57°44′ 9.65′	72°10′ 12.75′	86°36′ 16.49′	101°02′ 21.24′							4′-2″	2′-11½″	14½″	½″	5′-4″	14°26′	7°13′	17½
20′	12°48′ 2.24′	25°36′ 4.54′	38°24′ 6.96′	51°12′ 9.58′	64°00′ 12.50′	76°48′ 15.85′	89°36′ 19.86′	102°24′ 24.87′						4′-2″	3′- 1¾″	12¾″	7/16″	5′-4½″	12°48′	6°24′	20′
22½′	11°32′ 2.27′	23°04′ 4.59′	34°36′ 7.01′	46°08′ 9.58′	57°40′ 12.39′	69°12′ 15.52′	80°44′ 19.13′	92°16′ 23.41′	103°48′ 28.69′					4′-2″	3′- 2 1/16″	11 5/16″	⅜″	5′-5½″	11°32′	5°46′	22½′
25′	10°28′ 2.29′	20°56′ 4.62′	31°34′ 7.03′	41°52′ 9.56′	52°20′ 12.28′	62°48′ 15.26′	73°16′ 18.59′	83°44′ 22.41′	94°12′ 26.90′	104°40′ 32.39′				4′-2″	3′- 3¼″	10¼″	⅜″—	5′-5¾″	10°28′	5°14′	25′
30′	8°50′ 2.32′	17°40′ 4.66′	26°30′ 7.07′	35°20′ 9.56′	44°10′ 12.17′	53°00′ 14.96′	61°50′ 17.97′	70°40′ 21.27′	79°30′ 24.95′	88°20′ 29.14′	97°10′ 34.01′	106°00′ 39.81′		4′-2″	3′- 5¼″	8¼″	7/16″	5′-5¾″	8°50′	4°25′	30′
40′	6°46′ 2.36′	13°32′ 4.75′	20°18′ 7.16′	27°04′ 9.63′	33°50′ 12.16′	40°36′ 14.80′	47°22′ 17.54′	54°08′ 20.88′	60°54′ 23.52′	67°40′ 26.81′	74°26′ 30.38′	81°12′ 34.28′	87°58′ 38.60′	4′-2″	3′- 7 1/16″	6 13/16″	¼″—	5′-6¾″	6°46′	3°23′	40′
50′	5°28′ 2.39′	10°56′ 4.79′	16°24′ 7.21′	21°52′ 9.66′	27°20′ 12.16′	32°48′ 14.72′	38°16′ 17.35′	43°44′ 20.06′	49°12′ 22.89′	54°40′ 25.85′	60°08′ 28.95′	65°36′ 32.23′	71°04′ 35.71′	4′-2″	3′- 8 13/16″	5 1/16″	7/16″	5′-7 7/16″	5°28′	2°44′	50′
60′	4°36′ 2.41′	9°12′ 4.83′	13°48′ 7.26′	18°24′ 9.72′	23°00′ 12.21′	27°36′ 14.70′	32°12′ 17.32′	36°48′ 19.96′	41°24′ 22.67′	46°00′ 25.47′	50°36′ 28.36′	55°12′ 31.37′	59°48′ 34.50′	4′-2″	3′- 9¾″	4¾″	⅜″+	5′-7⅜″	4°36′	2°18′	60′
75′	3°42′ 2.42′	7°24′ 4.85′	11°06′ 7.29′	14°48′ 9.74′	18°30′ 12.24′	22°12′ 14.71′	25°54′ 17.25′	29°36′ 19.82′	33°18′ 22.43′	37°00′ 25.10′	40°42′ 27.82′	44°24′ 30.61′	48°06′ 33.48′	4′-2″	3′-10 5/16″	3 11/16″	⅜″	5′-8 1/16″	3°42′	1°51′	75′
100′	2°48′ 2.44′	5°36′ 4.89′	8°24′ 7.34′	11°12′ 9.81′	14°00′ 12.28′	16°48′ 14.77′	19°36′ 17.27′	22°24′ 19.80′	25°12′ 22.35′	28°00′ 24.93′	30°48′ 27.54′	33°36′ 30.19′	36°24′ 32.88′	4′-2″	3′-11¼″	2¼″	⅜″	5′-8¼″	2°48′	1°24′	100′



Counter-weighted hooks to pull car back to incline

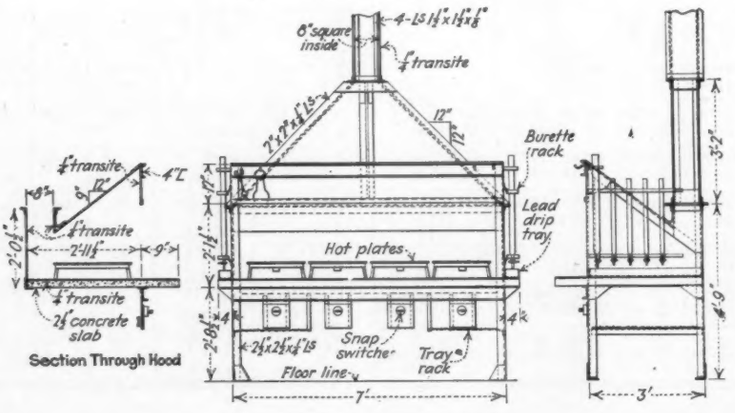
the hoist are released. The counterweights then draw the car back to the incline, and as the car goes over the incline the loops catch on the double hooks and unhook themselves from the car.

The car is a heavy one holding 6 cu.yd. and the hoist is of the remote control type, with a 250-hp. motor that brings the cars up at a lively gait. But the hooking and unhooking of the counterweight loops is smooth and certain, and the arrangement requires no attention from the hoist man.

An Efficient Fume Hood for Smelter Laboratory

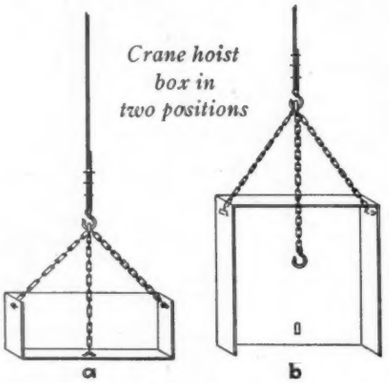
INSTALLATION of a modern forced-draft ventilating system in the laboratory of the Copper Queen smelter, Douglas, Ariz., was completed about eighteen months ago, as stated by H. J. Bishop in the Phelps Dodge issue (Oct. 27, 1928) of *Engineering and Mining Journal*. Fume hoods, of which there are eight, are constructed of transite board (pressed asbestos and cement) and steel. The general arrangement of one of these hoods is shown in the accompanying drawing. They are connected to two exhaust blowers by ducts of the same material as the hoods. Two roof ventilators, for removing fumes generated outside the hoods, complete the ventilating system. The hoods are equipped with electric hot plates and are supplied with low-pressure air connections.

General arrangement of four-plate hood used in Copper Queen laboratory



Safe Practice in Hoisting Rock From Pit

IN REMOVING ROCK from an open cut with crane and box, the box is usually suppported at three points, as shown at *a* in the illustration, discharge being effected by detaching the hook on the lip side, as in *b*. Frequently, after being dumped, the box

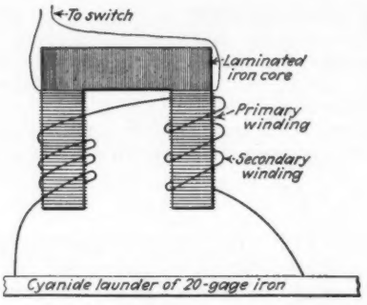


Crane hoist box in two positions

is returned to the pit with the hook detached. This practice is attended with certain risk to the workmen in the pit below as C. McManiman, of Rawdon, Que., points out, inasmuch as if the contents are sticky or frozen, some of it may stick in the box on dumping, only to fall into the pit, perhaps, as the box is lowered. The box should always be lowered in the horizontal position, as shown in *a*.

Launder Used as Heating Element to Avoid Freezing

A PROBLEM in handling cyanide in the flotation department of one of the Utah Copper Company's plants was solved with economy and dispatch. During the winter months, the launder conveying the cyanide froze. At first, the solution launder was placed in a larger launder and the intervening space packed with shavings, but this arrangement did not work. An electric heating device was thereupon tried. This

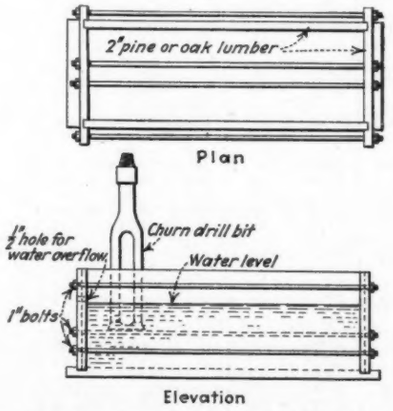


Scheme for heating launder

involved building a launder of 20-gage iron about 250 ft. long and set on wooden blocks. The launder itself was used as the heating element, 300 amp. at 12 volts being conducted through it. All trouble with the freezing of the solution was thus overcome. An old compensator coil was used for a transformer. On account of the length of the launder, cable connections are made at four different points to assure ample contact.

An Aid in Tempering Churn Drill Bits

PROPER TEMPERING of churn drill bits is perhaps the most important detail of churn-drill operation. The efforts of a skillful tool dresser



Box for tempering churn-drill bits

are sometimes nullified by lack of a suitable tempering box or water container. The one shown in the sketch is sturdy and well proportioned, and can be easily made.

COMMENT AND CRITICISM

Californians Oppose Passage of H.R.15,919 Now Before Congress

Geophysical Bill Regarded by Sacramento Chamber of Commerce Mining Department as Unworkable and Dangerous

To the Editor of "E.&M.J.":

Herewith is a statement of the policy of the mining department of the Sacramento Chamber of Commerce in opposition to H. R. 15,919, now before Congress, which may be of interest to your readers. This bill, known as the Geophysical bill, is regarded by our committee as unworkable and particularly dangerous to the precious metal miners of the West.

H. R. 1,019 introduced in this Congress is an attempt to improve upon H. R. 15,919, but it is also opposed by our committee for identical reasons.

R. L. KIMMEL,
Manager, Mining Department,
Sacramento Chamber of Commerce.
Sacramento, Calif.

The statement issued by the Sacramento Chamber of Commerce follows:

"The bill, containing the amendments offered by Senator Pittman, is inimical to the mining industry affected by its provisions and to the future of the Western mineral states. It provides: that locations of mining claims may be made in all instances where a legal discovery cannot be made upon the surface, but where the claims are expected to contain, at depth, copper, lead, zinc, gold, or silver, and their associated minerals, the actual existence of which can be demonstrated only through deep shafts or other similar workings.

"Lode mining laws are the only ones affected by the act. This is, upon its face, a discrimination in favor of lode mining. Large areas of lava-capped gold-bearing gravels exist, where, at depth, it is a moral certainty that gold can be found, but actual discovery cannot be made until a tunnel is run or a shaft is sunk to tap the gravel. However, the Land Department has held in some cases, where there is reasonable proof that a channel runs through the land, that it will be adjudged mineral in character and no other form of entry has been permitted. But the courts have invariably decided exactly opposite, and construed the mining laws to mean that a valid location can be supported only by actual discovery of mineral on the land.

"The phrase 'upon which a legal discovery cannot be made upon the surface,' opens a wide field. That phrase involves a question of fact, and means endless litigation between agricultural claimants on the one hand and mineral claimants on the other. The word of one man is as good as that of another, and experts vary in their opinions on many occasions. Who can say positively that minerals in paying quantities do or do not exist at depth anywhere along the western slope of the Sierras? A person may locate 320 acres, the maximum which may be located by one person under the act, claiming that he has reason to believe that minerals exist in paying quantities at depth, and yet, as far as our present geologic knowledge is concerned, absolutely nothing may warrant, in the slightest degree, a positive statement that such mineral does exist at depth or otherwise. Without surface indications, what miner would follow a totally blind lead? Without a vein, a feeder, a prospect, what has mining, in its accepted form of mineralogical definition, to fix its deductions upon?

"To throw open to the law courts the task of determining, as a question of fact, the scope of that phrase in each individual case presented, would mean not only the tying up of thousands of acres of land but the expenditure of millions of dollars in useless litigation.

"All the litigation that has engrossed the courts during the last seventy years would have to be thrown into the discard. We would again be confronted by problems concerning extra-lateral rights and the law of the apex—two elements in our lode mining law that we have settled fairly well, but that would, naturally, have to be litigated again because of the change in the organic law of lode claims.

"Holding of vast areas by corporations formed for that purpose might result. While the law prohibits the 'location by any locator' of more than 320 acres, nothing would prohibit one individual or corporation from purchasing an area of a million acres from the original locators and holding it against the world. All that is required is that an expenditure of $300 be made annually for each location, and group expenditures are authorized; that is, in a group of claims, all the money may be spent upon one claim, provided it is for the benefit of the whole group.

"This act will eliminate the man who has done more toward opening the west than any other individual, and that is the prospector. Should this bill become law, he would pass entirely out of the picture. He would be supplanted by lawyers and theorists.

"The act is wholly premature. Some time in the future of scientific research and human endeavor, mankind may solve the secrets locked in the bosom of Mother Earth without the expense of digging down and finding out by a practical illustration. But that time has not yet come to the lode-mining industry. Our most skilled experts frequently miss an ore-shoot while actually following the vein in the ground, and science has not, as yet, reduced the science of geophysics to such simple proportions that ore may be accurately and definitely located hundreds of feet below the surface, so that its strike, depth and pitch may be accurately delineated and recorded without sinking or drifting to it.

"Land on which a discovery has not been made within five years after date of location will not be relocatable under the act. What does that mean? Does it mean that, simply because one person cannot find the mineral deposit within five years, no mineral exists between the surface and the center of the earth? If that is the extent of the act, then it will defeat its own purpose. From the lawyer's viewpoint, however, that provision means simply the same locator may not relocate the same ground. In fact he does not have to locate the same claims. He has no lode line, no visible surface indications to show where or in what direction the lode may strike, and therefore is not bound by any of the present rules relating to mining locations. If his first locations run east and west, he may, after the expiration of five years, relocate new claims by running them north and south.

"Our oil leasing act has positive provisions relating to discovery and to the prosecution of drilling operations. Two years is the limit, but the Secretary of the Interior grants extensions of time, or rather did, until the Presidential order withdrawing all oil lands became effective March 12, 1929. Who can say whether the same rule may not be followed under this 'geophysical act'?

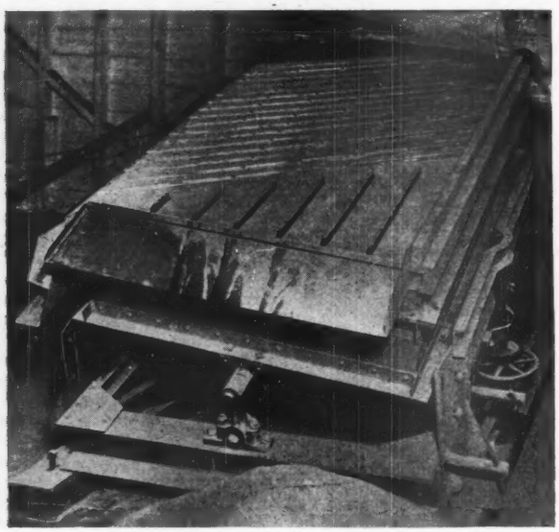
"Finally, the act is merely the continuation of an attempt of the federal government to arrogate unto itself the last remaining resources of the public-land states. It has taken our oil, our coal, our standing timber, our grazing, our water, our borax, our phosphates, our gas, part of our wild game, part of our fish, and now it wants to take over the control and operation of our metalliferous minerals. If this act passes, then we may as well turn over to the federal government the civil control of our state. Without natural resources, little remains to develop. When the source of supply is controlled by Washington through an official whom you do not elect and cannot remove, your state has passed the zenith of its development.

"Once the government obtains control of any resource, development stops, because the Congress refuses to go on with the program. That has been the history of governmental control and ownership since it was first started in the United States."

INDUSTRIAL PROGRESS

Concentrating Table and Trolley Haulage Appliances Feature Recent Equipment

NEW mining and metallurgical equipment that has recently been brought to the attention of the editor includes a dry concentrating table for recovering gold, platinum, tin and other metals from gravels containing them. As shown in the accompanying photograph, the table is of the jig type and has riffles diagonally placed so as to be self-cleaning, the concentrate being taken off the side, together with a small percentage of middling, and the tailing flowing over the top of the riffles to the end of the table where they are rejected.



On this dry concentration table, the pulp is kept in suspension by the alternating use of air which is blown through the airplane-cloth deck

One of the principal patented features is the alternating use of air, which is controlled by two valves, one under the table and one on top. Thus the material is kept in constant agitation and suspension, preventing the table top from wearing. This top is made of heavy airplane cloth, underlaid with metal screens.

The table has two compartments, a large one for air, from which it is forced through to a smaller compartment. By this means a more equal distribution of air pressure throughout the top of the table is obtained.

According to Walter Duisenberg, 35 Post St., San Francisco, who controls the rights to this table, a test run was made with it in 1927 by Abbot A. Hanks, Inc., of San Francisco. The test was made on a gravel deposit at the old Summitt placer diggings near Johannesburg, Calif., to see what the machine could do under a continuous 24-hour run. The site selected was in a ravine, with banks on either side, which facilitated transportation of the material to the feed hopper. The gravel treated was loose and not in place and had the appearance of being tailing from previous dry washing operations. It was first put through an 8-mesh screen. Coarse sizes were rejected and the fines alone passed over the concentrator. The percentage of fine material was high, probably above the average. After screening, the fines were weighed before being fed to the table.

The test started on Oct. 16, 1927, and continued without interruption for 24 hours, the amount of gravel being treated amounting to 53.125 tons. Toward the end of the test, the supply of screened gravel was exhausted and the tailing from the end of the machine was fed back into the hopper and re-treated. The amount of gravel thus re-treated was estimated to be about 18 tons. This re-treated material was not sampled. Flow of feed through the machine was not uniform and at times the deck was badly overloaded in an attempt to see how large a tonnage could be crowded through. At one time the rate of feed was 4 tons per hour. Even under this condition, no packing of concentrate behind the riffles took place. The air blast was sufficient to keep the black sand loose. During the test, shutdowns were made for tightening the belt, oiling the machine and readjusting the gas engine, by which it was driven. The total time thus lost was not more than 30 min. At the end of the run examination showed that the machine was still in good working condition and that no wear could be noticed on the cloth top.

Head and tail samples were taken every 20 minutes during the run on the original material. Assay showed that the free gold in the head samples was 4.8c. per ton, equivalent to 7.2c. per cubic yard. Free gold in the concentrate was $2.46 per ton. The tailing contained only traces of gold.

The engineers making the above test reported that in their opinion the machine could be considered a commercial unit and that it might be expected to give satisfaction under working conditions. Another test made in San Francisco, in a shop, with the same machine on one ton of gravel having a calculated value of $2.18 per ton, gave a concentrate having a calculated value of $99 per ton.

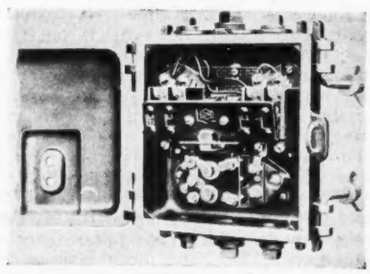
Starters Made Dust Tight

Development of dust-tight inclosing cases for its across-the-line automatic starters has been announced by the Cutler-Hammer, Inc., Milwaukee, Wis. These are in two types: For motors up to 5 hp. the case is of cast iron and for larger sizes is of heavy welded boiler plate. A soft rubber gasket is provided between cover and case. The inclosure is also weatherproof. Start, stop and reset buttons are mounted directly in the cover. These are intended for installation in mines and in plants where the air is very dusty.

Simple Pyrometer Developed

A simple pyrometer which is not so large even as an ordinary slide rule and can be carried in the pocket with equal facility has recently been put on the

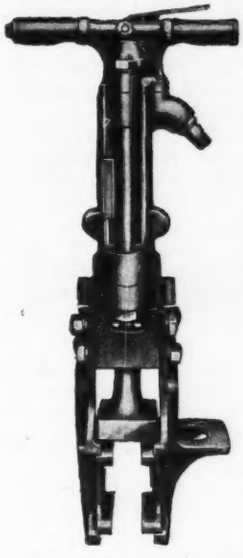
Dust-tight case protects this automatic starter



market by Viozone, Ltd., 19, Cursitor St., London, E. C. 4. Two strips of material comprise the frame, between which is a strip of shaded glass graduated from clear to opaque. A runner similar to the runner on a slide rule, is of opaque material, but is cut by a hole through which the instrument can be sighted on a heated body. The slide is then pushed slowly from left to right until the glow of the heated material can no longer be seen through the hole, whereupon the temperature will be found indicated at the edge of the runner. This instrument, is said to be ideal for controlling purposes, requires no adjusting, and can be used at any reasonable distance. An eyepiece is attachable where excessive heat is encountered. The price is 45s. complete.

For Driving Sheeting

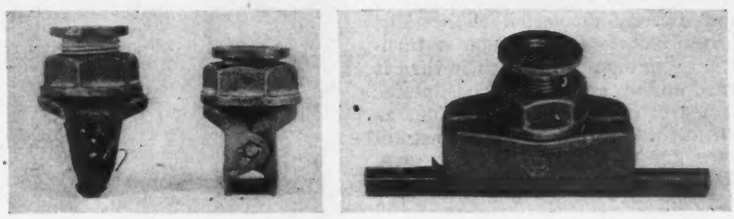
One of the accompanying cuts shows an air tool for driving sheeting. This is designed primarily to take wooden sheeting, although light steel sheet piling can also be successfully driven, according to the Chicago Pneumatic Tool



An air tool for driving sheet piling

Company, New York, which makes it. This tool (model CP-116) will do the work of eight to ten men equipped with mauls. Sheeting driven by it can be used over and over, since there is no tendency to "broom" as when driven by hand, thus effecting a substantial saving in material.

Low air consumption is claimed for the tool, which is of the valveless type, having only one moving part, the piston. The weight is 105 lb. The tool can be equipped to accommodate various sizes of sheeting from 2 to 3 in. inclusive. The handle can be assembled parallel to the sheeting, or at right angles, as shown in the illustration. By changing the front end, the driver can be converted into the company's CP-116 demolition tool.



Three views of a new trolley clamp

An Improved Trolley Clamp

The trolley clamp is the most important fitting in the trolley system. When the clamps fail and release the trolley wire, haulage ceases and a reduced output for the day is inevitable.

In a clamp the important features are holding power, wheel clearance, ease of installation, and length of life. Holding power should receive first consideration when selecting a clamp. In practically every mine there are sections in which the top is bad. Rock falls in these sections may vary from a few small pieces to several tons. The clamp should hold the wire under small falls but release it without injury under heavy falls.

Wheel clearance is another important item. On tangent lines with new trolley wheels very little arcing will be noticed, irrespective of the thickness of the clamping jaws. In a short time the wire wears a deep narrow groove in the wheel. After this groove is established the wheel will strike a clamp with thick jaws. This is particularly noticeable on curves. When the wheel strikes a clamp it jumps and an arc results. The groove in the wheel becomes burned and pitted and its life shortened. However, the wire receives the bulk of the punishment. The arc burns the wire at the same point with each passage of the wheel. The section is soon greatly reduced and in time breaks under a slight strain.

High labor costs make ease of installation also important. The self opening feature lowers the cost of stringing the lines. For clamps to be economical it should be possible to reclaim and reuse them after a section is worked out.

Westinghouse has introduced the "Archi" clamp which fulfills all these requirements. A load in excess of 3,800 lb., is required to pull a 4/0 grooved wire from this clamp. Due to its construction it is possible to secure this strength and keep the jaws thin enough to eliminate arcing. By means of its flexible self-opening feature the trolley wire may be inserted and clamped with minimum effort. Its construction and rust-proof finish enable this clamp to be used over and over again. The clamp is made in both the aligning and non-aligning type. It fits 2/0 to 6/0 grooved or Fig. 8 wire.

Fitting for 6/0 Wire

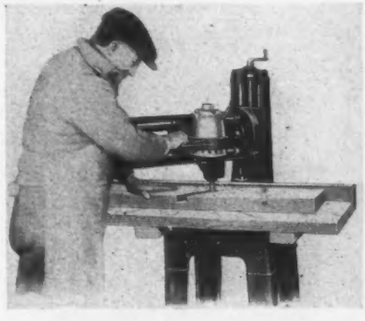
As the length of haulageways increases in the larger mines, it is necessary to use large locomotives. The collection of current, particularly where 250-volt circuits are used, is a vital factor. Many of these mines are now using 6/0 wire on their main haulage ways. The cross-sectional area of a 4/0 wire is 211,600 C.M. and of the 6/0 wire is 336,400 C.M. or an increase of 59.4 per cent. On the grooved section, due to the large radius on the bottom lobe of the wire, the surface of contact with a trolley wheel is increased 50 per cent.

Of course this wire has greater mechanical strength than 4/0 and will withstand heavier rockfalls without injury. Wire which has been worn down on the main haulage is customarily used for advance work. When a 4/0 section is used it is usually worn and burned to a 2/0 section before it is moved forward. This section does not have sufficient current-carrying capacity to keep the voltage up at the fact. It is also weak mechanically and will break under a light rock fall. The 6/0 wire should be worn to a 4/0 section and then carried forward. The 6/0 trolley wire is furnished in three sections, namely, grooved, Fig. 8 and Roebling Fig. 9.

The Westinghouse standard "Archi" clamp will fit any of the above sections as well as 1/0 to 4/0 groove or Fig. 8 wire. The type SL splicer and the double-gap section insulator will fit any of the three 6/0 sections. The type CF overlapping runner trolley frog is adapted to the use of the 6/0 sections.

A Versatile Saw

A portable electric-driven saw that can be applied to many different kinds of work has been developed by J. D. Wallace & Company, Chicago. It takes its power from an ordinary lighting or power circuit, alternating or direct, and



This saw may be used for many different kinds of work

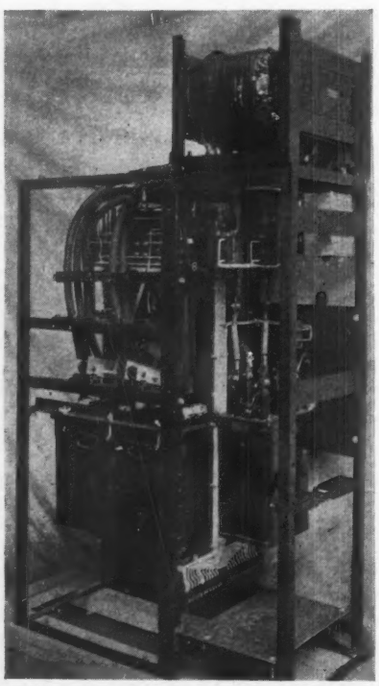
25, 30, 40, 50 or 60 cycle. It is known as the "Workace" radial saw and is easily adjusted to cut at any angle, for cross-cutting or ripping, dadoing or grooving, rabbeting, routing, and panel raising, as well as straight line work.

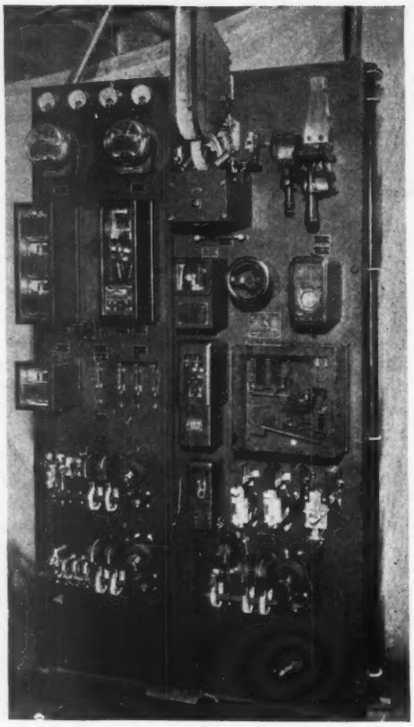
It works from above. The motor is built in and directly connected to it. The combined unit is mounted on a turntable, 6 in. in diameter, which in turn is mounted on two heavy steel rods, placed 5 in. apart to prevent any spring, as shown in the illustration. The rods are mounted in a radial arm, which, in turn, is mounted in the pedestal on a turntable, 10 in. in diameter, permitting the arm to be set in any position. The pedestal is also mounted on a turntable, 10 in. in diameter. By means of these three turntables the machine is readily placed in position for any kind of cutting.

Small Space Required by New Switching Equipment

General Electric has announced a new design of automatic switching equipment for synchronous motor-generator sets in mining service. This equipment occupies about half the floor space of previous designs and has other advantages as well. The new design is for use with motor-generator sets rated at 50 to 300 kw., 2,300 volts a.c. and 275 volts d.c., the standard mine voltages. Its principal new features are the use of a new starting and running contactor and the compact arrangement of the high-tension switching equipment. The new contactor, in itself very compact, is mounted in an angle-iron framework together with the oil circuit breaker, current transformers and potential transformer. The starting auto-transformer is mounted on top of this frame. All the high tension wiring among these various parts is done by the manufacturer. All the control leads connecting to the switchboard have been brought to a terminal block conveniently near the bottom of the framework.

A compact starting and running unit for a 275-volt, 200-kw. synchronous motor-generator





Compact automatic switching equipment with a d.-c. recloser

Protection is provided at all times for the machine and equipment against the following abnormal conditions of operation: a.-c. overcurrent; a.-c. undervoltage; single or reverse phase voltage; d.-c. overcurrent; d.-c. reverse polarity; d.-c. reverse power; d.-c. undervoltage; incomplete start; loss of generator excitation; overheated bearings; overheated windings; phase unbalance; overspeed; underspeed; and high d.-c. bus voltage.

The new equipment reduces the space occupied by 40 per cent, saves time and cost of installation, resulting from reduction in wiring and connecting; it can be moved easily, moreover, and affords greater safety to the operators.

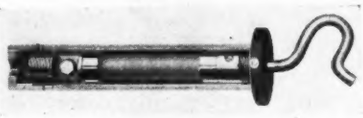
A Better Trolley Tap for Portable Electric Machines

Those concerned with mechanical mining and lower production costs will be interested in the announcement of a new fused trolley tap made by the Ohio Brass Company. This tap is a means for connecting the trailing cable of portable electrically driven machines. Being a fused device, it affords protection to motors and trailing cables against the possibility of over-loading and subsequently burning out. In addition to protecting the machines and assuring continuous operation, it affords safety protection to the men. Any trouble with motors which might cause arcing is smothered by the fuse.

This Form-3 tap, as it is called, is practically indestructible. It combines to a marked degree sturdiness and simplicity. It consists of only five parts: two contacts, the fuse, the case, and the hand guard. The case is constructed of heavy phenol-canvas and is made to engage either a hook or clamp on one end and a trailing cable on the other. Threaded internally, it screws onto a copper collar at the bottom contact plug and to a copper collar on the hand guard, so that there is a canvas-to-metal threading between case and contacts which removes all danger of the threads wearing away or of the tap pulling apart.

An ingenious method is used to obtain absolute contact between fuse and terminals. A ferrule-type, non-renewable fuse is seated between two slotted contact terminals, making a butt contact as the cable end of the tap is screwed into place. This arrangement not only enables perfect contact to be made, but also adds materially to the ease of fuse renewal. In this operation neither pliers nor screw driver is needed. Fuse renewal is made by merely unscrewing the cable terminal socket of the tap, which releases the old fuse. The new fuse is then inserted in the slotted socket, and by screwing this socket into position on the tap, connection between fuse and sockets is re-established and the tap is again ready for use.

The combination clip and butt contacts into which the fuse fits are made of hard drawn copper of good cross sectional area, affording a generous amount of conductivity. The cable is secured to the copper terminal with a large-size cap screw. As there are no clips on the fuse, the tension of the cable is not transmitted to it. Neither is there the possibility of the fuse becoming damaged by the twisting action of the cable.



An improved trolley tap for portable machines

A fuse of the same length and diameter is used for the entire range of voltages and amperages. These fuses range in capacity from 250-650 volts, and from 100-400 amp.

To remove all danger of the arc leaping through the fuse and burning the tap case when a fuse blowout occurs, a specially designed non-renewable fuse is being made by the company. The fuse case is made from fiber $\frac{1}{8}$-in. thick and the fuse element is embedded in a long fiber asbestos filler to snuff the arc when the fuse blows. One can readily see that the case of the fuse itself is strong enough to confine the blow-out within the fuse case so that all possibility of a damaged tap case is removed.

This new trolley tap is furnished in two styles. One a hook-type tap which hooks over the trolley wire; the other a clamp-type which clamps the top groove of the trolley wire, thus offering no obstruction to the passage of current collectors on locomotives. The clamp will grip 1-0 to 6-0 grooved and Fig. 8 wires, 1-0 to 4-0 round, also Roebling special No. 9.

Personal Notes

C. R. Ince has joined the metal sales department of the St. Joseph Lead Company.

A. B. Young, assistant manager of International Smelting, is in Washington on business.

J. K. Osborne is no longer connected with Sudbury Diamond Drilling, and is at present at Negaunee, Mich.

President Herbert Hoover has been elected honorary member of the American Institute of Electrical Engineers.

Julius Loeb, vice-president and treasurer of American Metal, sailed on the "Majestic" on June 22 for a pleasure trip of seven weeks in Europe.

A. H. Collier, vice-chairman of Wiluna Gold, has returned to London after an inspection of several Western Australia mines.

John D. Ryan, chairman of the board of directors of the Anaconda Copper Mining Company, has returned from Europe.

E. C. Jacobs has been appointed general manager of the Black Dyke mine, near Kingman, Ariz., which is being reopened by eastern Canadian interests.

Paul Armstrong has opened offices at 422-424 New Birks Building, Montreal, and has resumed independent practice as a consulting mining engineer.

Prof. E. B. Branson, chairman of the department of geology of the University of Missouri, will lead a party of students this summer who will map and study formations near Lander, Wyo.

Dr. A. P. Coleman and **Prof. E. L. Walker,** of the University of Toronto, will attend the International Geological Congress to be held at Pretoria, South Africa, commencing July 18.

R. J. King, of the Tonopah Belmont Development Company, is making an examination of the Keyes mine, on the Comstock lode, which his company has under option.

Frank È. Sheppard, superintendent of the Denver mint, recently addressed a meeting of Denver business men on the past, present and future of Colorado mining.

Dr. H. Darwin Kirschbaum, of the California Institute of Technology, has been appointed associate professor of chemistry at the Colorado School of Mines.

Lloyd Hoskins has been made superintendent of operations which have been recently resumed by Alta Tunnel & Transportation in Big Cottonwood Canyon, near Salt Lake City.

J. M. Kleff, mining engineer, of Leadville, was recently appointed by Governor Adams to the Colorado metal mining fund board, to succeed the late **Patrick Hart.**

James S. Colbath, assistant manager of Benguet Consolidated Mining, arrived in San Francisco on June 25 from a vacation trip in Europe, and will sail on the "President Wilson" for the Philippine Islands on July 12.

Dr. R. E. Tuck of the engineering firm of Wright, Boydell, James & Associates, has been appointed geologist and engineer in charge of the Sudbury Lode Mines, Ltd., operating in the Sudbury district of northern Ontario.

Fred J. Siebert has left Nevada, and has purchased a home at Savoy Park, New Rochelle, N. Y. After a business trip to Europe, on which he sailed June 21, he intends returning to New York City to enter consulting practice.

Max Kraut recently left New York for Cusihuiriachic, Mexico, where a new flotation unit, handling oxidized silver ore pulp, is going into operation in July. Mr. Kraut plans to visit Newfoundland before returning to San Francisco.

Leslie Urquhart, D. P. Mitchell, and **Charles A. Mitka** sailed for Sydney, New South Wales, from Vancouver, B. C., on June 26, en route to the Mount Isa silver, lead, and zinc property in Queensland.

Elias S. Gatch and **Philip N. Moore,** both of St. Louis, have been appointed members of the Missouri State Board of Geology and Mines by Governor Henry S. Caulfield for a term of four years each, to expire on May 22, 1933.

Ira B. Joralemon, consulting geologist of San Francisco, and **Percy H. Kittle,** secretary-treasurer of Ohio Copper, were in Salt Lake City, Utah, recently, to inspect the company's property at Bingham. They were accompanied by **J. B. Lane,** of Reno, Nev.

W. C. Broadgate, general manager of Silver Pheasant Mines, at Cleator, Ariz., is in New Haven, Conn., attending the annual company meeting. In his absence, **F. H. Clark,** consulting engineer of the company, will be in charge of operations.

Roy V. Wright, president of the United Engineering Society, will head the committee which is to arrange for the reception, and entertainment while in this country, of the European delegates to the World Engineering Congress at Tokio, Oct. 30.

Donald Callahan, president of Callahan Zinc-Lead, has been elected vice-president of North American Mining & Smelting, a unit of Associated Metals. **J. L. Coleman** is now resident vice-president of the company with headquarters at Deer Lodge, Mont.

Homar L. Johnson, assistant editor of *Engineering and Mining Journal,* has been appointed assistant to the secretary of the A.I.M.E., vice **Dr. T. T. Read,** recently selected to succeed the late **R. M. Raymond** as professor of mining engineering at Columbia University.

Hamilton M. Brush, vice-president of American Smelting & Refining, sailed for London from New York on June 19 on the "Olympic." Mr. Brush will attend the world conference of lead producers. He expects to return to New York late in July.

Haughton Dunkin, of Melbourne University, has been awarded the metallurgy prize of the Australasian Institute of Mining and Metallurgy for the best paper on mining and metallurgical subjects by students in Victoria during 1928. The Tasmanian prize was won by **E. C. R. Spooner,** of Hobart University.

L. J. Parkinson with Mrs. Parkinson and their two children sailed on the "Samaria" for London on June 22, following a vacation of several weeks in the United States. Mr. Parkinson has for several years been assistant managing engineer for the Angola Diamond Company, operating alluvial mines in Portuguese West Africa. He is returning to South Africa for the Anglo-American Corporation.

Dr. Eric Randolph Jette, now associate professor of chemistry in New York University, has been appointed to a professorship in the School of Mines of Columbia University. Professor Jette was born in Lancaster, Pa., September 30, 1897. He received the degree of B.S. from Franklin and Marshall in 1918. He took his master's degree in 1920 and his Ph.D. in 1923, both at Columbia, and for two years he was instructor in chemistry at that institution. Since 1926 he has been associate professor at New York University.

OBITUARY

Frank Nicholas, purchasing agent of Calumet & Hecla, died in Detroit, on June 6. He was 52 years of age, and was at one time connected with the Houghton Mining Gazette.

Oliver Ames, senior member of the board of directors of the General Electric Company, died at his home in North Easton, Mass., on June 18. Mr. Ames, who was 65 years old, had been a member of the board since 1893.

Thomas J. Jones, of Hillsborough, Calif., died suddenly on June 18 at Campo Seco, Calif., where he was engaged in operating a copper mine which he and his associates had acquired, reopened, and equipped with a milling plant. Mr. Jones had been in failing health for several months and was working at the mine in defiance of his doctor's orders. He was 60 years old, and was employed by Russo-Asiatic Consolidated before the World War, in Russia, Siberia, and Asia in developing mining properties. He left Russia after the War, and came to California where he engaged in professional work. He joined the A.I.M.E. in 1892.

Book Reviews

Increasing Industrial Efficiency by Standardization

INDUSTRIAL STANDARDIZATION. *New York: National Industrial Conference Board, Inc. Pp. 306. Price $3.50.*

INDUSTRIAL standardization has been a paramount factor in the recent economic progress of the United States. According to this treatise, "cumulative evidence points unmistakably to the conclusion that it is one of the most significant and far-reaching methods for increasing industrial efficiency to the benefit if properly used, of all interests concerned." "Tangible and trustworthy facts regarding the achievements and economies of standardization," however, "are few and far between," and "the achievements in the past are but guide-posts to possibilities in the future."

Such, in brief, is the summarizing by the National Industrial Conference Board of its findings. Although the board thus indicates certain reservations in evaluating ultimate economic effects, it nevertheless is inclined to attribute great potential value to the effects of standardization on social and cultural progress, provided the evidence found in support of the net economic benefits of the movement should prove conclusive. Contrary to popular impression in many quarters—that standardized consumers' goods and standardization in industrial and commercial methods tend to develop stereotyped living conditions and habits—the board declares that "if the machine (through standardization and mass production) is able to democratize leisure, it may be opening the way for the greatest cultural renaissance in the history of the world."

Standardization, the report points out, means many things in addition to the mere standardizing of product as to size, quality, design, or of methods and procedure in the productive process proper. It is applied in increasing degree to the functions of business procedure in all its branches, as in purchasing specifications, in distribution methods, transporting and handling, clerical work, finance and communication, always with the immediate aim of economizing material, effort, and time. "So pervasive is the application of the principle that . . . we have failed to appreciate its significance, the extent and manner by which it is being systematically advanced, its relation to industry, to government and to the public and the problems to which it has given rise."

"Standardization should be regarded as a tool, a method, a device or a technique for achieving certain ends," the Conference Board declares in the concluding chapter of its study. Whether or not advantages outweigh disadvantages is found to depend entirely on what use is made of standardization. It may retard or it may promote industrial progress. In practice, judgment as to particular standardization projects or as to standardization in general must rest on a satisfactory answer to the following three questions, the board declares:

1. Does standardization have the effect of forwarding technical scientific improvement of processes, techniques, and equipment?

2. Does standardization make possible a higher average standard of living?

3. Does standardization relegate problems already solved to their proper place, the field of routine, leaving creative faculties free for the problem still to be solved?

Taking into account only standardization reached by conscious, deliberate, selective process, and by judging the effects in terms only of what is known about standardization as practiced today, "available evidence emphatically supports an affirmative answer to the three questions," the Conference Board concludes.

The danger that standardization may impede industrial and technical progress by tending to stereotype existing methods and designs is recognized, and to avoid it the board declares that existing standards and methods must be carefully and constantly checked with latest improvements, and machinery for constant and expeditious revision must be provided. For evidence that the standardization movement in the United States is thus successfully avoiding a stereotyping effect, the board points to the fact that the large industrial American organizations most active in the field of standardization also are the ones that maintain the most active and progressive scientific research laboratories, that constantly evolve new processes and commodities, and that co-operate most actively with the various private and official bureaus in evolving new standards.

The board's study takes into account the fact that standardization of product, through its inseparable concomitant, mass production at lessened production cost, has shifted the major industrial problem away from production to marketing, with the net effect that the ratio of marketing costs to production costs is steadily increasing. This creates a situation that in part offsets the advantage of standardization itself, but this, the board believes, may in part be remedied by simplifying and systematizing marketing technique. "To the extent that simplification of the channels of distribution may handle this difficulty, standardization can be used to raise still further the purchasing power of the daily wage."

The board's study reveals the phenomenal growth, in all industrial countries, particularly during and since the war, of a technique of standardization "which plays a basic and necessary part in machine industry." But it also implies a warning that the eventual effects are as yet not wholly clear; that a considerable part of the available data regarding its advantages had to be set aside as of dubious authenticity or as irrelevant, and that "many questions regarding the effects of standardization cannot be answered, even tentatively, by an appeal to evidence."

R. M. DAVIS.

PRACTICAL RAILWAY PAINTING AND LACQUERING. *By Hengeveld, Disney and Miskella. Published by Finishing Research Laboratories, Inc., Chicago. Distributed by Simmons-Boardman Publishing Company, New York. Pp. 267. Price $3.50.*

THIS VOLUME is primarily a handbook for railroad men, including technical engineers, superintendents, and purchasing agents. Those mining companies that have their own railroads and shops will probably find it advisable to bring the book to the attention of the employees in their transportation department. The book is divided into five parts, the first 140 pages being devoted to general information on the subjects, among others, of spraying and accessory equipment, abrasives, lacquers, sand blast and portable cleaning equipment, and modern testing methods. Part II, consisting of 38 pages, is devoted to a discussion of the painting and lacquering of locomotives and freight and passenger cars. Part III deals with the painting of signal equipment. These two sections have been prepared by H. Hengeveld, master painter of the Atlantic Coast Line Railroad.

Part IV deals with the painting of bridges, buildings, and water service, and has been supplied by C. P. Disney, bridge engineer for the Canadian National Railways. The position of the two authors thus far mentioned may be regarded as a sufficient guarantee of the authoritativeness of the subject matter. The concluding section of the book is concerned with the lacquering of electric railway cars, with which mining companies would have little to do. As a whole, the book will undoubtedly prove of value to those responsible for the maintenance of equipment.

YEAR BOOK OF THE AMERICAN BUREAU OF METAL STATISTICS. *Seventh Annual Edition, 1928. New York: American Bureau of Metal Statistics. Pp. 112. Price $2.*

This annual volume is one of the most valuable, and frequently used, in *Engineering and Mining Journal's* editorial offices, as it must be in the offices of any organization or individual directly concerned with the non-ferrous metal industry in its larger aspects. Statistics may deserve their reputation as dry and dull, but to us this volume that Mr. Ingalls and his staff turn out each year is as interesting as any other printed matter that comes to the office.

NEWS OF THE WEEK

Summary

ARGUMENTS for and against an increase in the graphite tariff were presented before the Senate sub-committee at Washington last Friday. Page 1054.

* * *

Howe Sound has started producing from the No. 5 or Santo Domingo shaft of its Potosi unit in Chihuahua, Mexico, to take the place of the output from its Calera unit, which was permanently closed at the end of May. Page 1053.

* * *

An additional Diesel engine is being added to the Old Dominion power plant at Globe, Ariz., and the concentrator is being enlarged so as to permit maintaining production despite the lower grade of material handled. Page 1055.

* * *

Sherritt-Gordon copper concentrate will be treated at the Hudson Bay Mining & Smelting smelter at Flin Flon, Manitoba, and the zinc concentrate will go to a plant to be built in eastern Canada, according to an announcement by the company. Page 1052.

* * *

The entire mechanical plant at the Howie gold mine, owned by Jackson Gold Mining, near Waxhaw, N. C., has been electrified, preparatory to resuming mining and milling operations. Page 1055.

* * *

Mayflower-Old Colony has struck a 15-ft. vein in exploratory work on the 1,700 level of its property in the Michigan copper district. Page 1053.

* * *

Six parties of geologists, under the direction of John A. Dresser, of Montreal, are conducting investigations in Quebec at present. Page 1056.

* * *

Cyprus Mines will install a Nordberg hoist at its copper mine near Skouriotissa, Cyprus, where a new shaft is being sunk. Page 1052.

Drilling Continues to Indicate Tremendous Orebodies in Rhodesian Copper Field

Summary of Results at Various Properties Shows Uniformly Favorable Results—Apparently All Essentials for Economical Development of Deposits Are Available

By George L. Walker
Special London Correspondent

GEOLOGICAL investigation and drilling in Northern Rhodesia continue to give almost uniformly good results and to disclose the existence of tremendous orebodies of copper. With ample capital procurable and with nearly all the essentials for production of copper at low cost available, the future of the companies appears bright. The following summary presents only a few of the salient facts in connection with this field:

From the southeast end of the Roan Antelope orebody to No. 9 drillhole in the company's Extension area is about 6 miles. Drilling has not only shown the ore to be continuous throughout this distance and to average at least 3¼ per cent, but hole No. 9 has cut 30 ft. averaging 3.49 per cent copper. Before this point is reached, going northwest, the two apices of the orebody begin spreading apart, and this continues to an extent to make it apparent that all but two very small corners of the Muliashi area of 6,000 acres beyond carries ore.

I have used the word "apparent" advisedly. Such extension of the ore is already being proved by drills, and geological investigation by Rhodesian Selection Trust has led that company to mark on its concession map: "Muliashi West Extension," "Muliashi Northwest Extension," and "Muliashi East Extension," and also to start drilling the last named area. Muliashi is a continuation of the Roan Antelope deposit. The property, which is under option to Roan Antelope, is 3¾ miles long and 2½ miles wide. The northwest boundary of Muliashi's area is 10 miles from the southeast end of the ore deposit, in the Roan Antelope property. So the expectation of finding the ore extending far out on other sides of the Muliashi property than the one on which it already has been proved is indicative of the enormous size of the deposit.

As will be recalled from maps of the Roan Antelope deposit which have appeared in *Engineering and Mining Journal*, the outcrops of the ore in the southeastern portion of the area are roughly 2,500 ft. apart. In the portion of the area completely drilled well over a ton of ore appears to be underneath each square foot of surface. If this proportion were to hold for areas remaining to be drilled there would be more than 100,000,000 tons in the original Roan Antelope and Extension properties, and approximately an additional 250,000,000 tons in Muliashi. How much farther the deposit may extend is conjectural, but geological conditions point to its continuance under a vast area.

The N'Changa deposit has been tested at intervals over a distance of nearly 3 miles. Where it is being drilled by Rhodesian Congo Border beyond the N'Changa property end-line, high-grade ore is revealed. Hole N.E.5, for instance, after cutting 65 ft. the core from which averaged 6.61 per cent and the sludge 8.58 per cent, went through another 15 ft. that appeared to average 37½ per cent copper. Now N.E. 6 has been completed, showing 125 ft. of ore averaging over 7 per cent. Though this hole is understood to be some 1,500 ft. distant from N.E.5 it has cut a similar belt of great richness.

Unfortunately the drill records are incomplete. In the section of greatest richness the core recovery was poor, due presumably to the ore being almost wholly malachite, and most of the sludge was lost. The manager's estimate of the average of a belt 20 ft. thick in hole N.E. 6 is 20 per cent copper. Only 30 per cent of the core was recovered, but what was recovered averaged 30 per cent copper. The N'Changa syncline expands sufficiently towards the west to separate the apices of the mineralized beds to 1½ or 2 miles. The ore so far encountered in this deposit is chiefly oxide, but increasing proportions of sulphide are being met as the holes penetrate the ore at greater depth, and on the River Lode side of the syncline a large and very rich mine of copper sulphides is being developed.

At Bwana M'Kubwa's N'Kana property, of 34 diamond drill holes completed, all spaced far apart and six cutting the ore at depths varying from 1,100 ft. to 2,171 ft., only three failed to find commercial ore. Four more of the

holes found ore averaging less than 3 per cent, but the other 27 show all the way from 10 ft. to 68 ft. of ore averaging from 3.20 per cent to 6.49 per cent copper. Geological conditions in this property indicate a further vast extension of the ore area, yet to be drilled.

In the Rhodesian Selection Trust area, the two deposits most extensively drilled—Mufulira and Chambishi—show high-grade ore over great widths; but the tendency there seems more toward big shoots of enrichment than unvarying continuity of mineralization. At Mufulira six holes strung along the strike for a distance of a mile disclosed ore averaging 70 ft. wide and containing an average of 5.36 per cent copper, of which only small amounts were in the form of oxides.

No one has any clear idea of the extent of the Central African copper field or would venture to guess how many more important deposits of ore are likely to be found. Over 100 miles west from N'Changa, however, is the Kansanshi mine, occupying such a position that it is surrounded by the Rhodesian Congo Border Concession. Kansanshi is developing what promises to be a very large tonnage of approximately 10 per cent copper ore in veins and replacement deposits. This is indicative of the far flung character of the copper mineralization in that remarkable region.

Though most of the ore so far developed in Northern Rhodesia is in a bed of shale, which corresponds to the upper bed in the Bwana M'Kubwa mine (See cross-section drawing on p. 838 of *Engineering and Mining Journal-Press* of May 23, 1925), the drilling has made it apparent that two strata below this are often richly mineralized. Triple-bed mineralization certainly occurs at Mufulira, at Chambishi and in Roan Antelope's Muliashi property. Possibly the great width of ore and remarkable richness disclosed by Rhodesian Congo Border in the extension of the N'Changa deposit results from all three beds carrying copper.

Similar enrichment of the underlying beds may possibly be found at many points. It will be a simple matter to test them in future years from underground workings by diamond drilling, and to mine such ore as is found through crosscuts. These lower beds are a potential source of a considerable additional tonnage of ore for all the mining companies.

Union Minière du Haut-Katanga is producing at the rate of 150,000 tons of copper annually, or more than twice as much as six years ago. From its Bwana mine, Bwana M'Kubwa should soon be producing 8,000 tons yearly, and it has the money raised to erect a plant of 5,000 tons daily capacity at its N'Kana property. Roan Antelope is getting in the equipment and completing the foundations for its plant which should make possible an output of 50,000 tons of copper in 1931. A railway, only 13½ miles long, is being built to the Mufulira property, which will be brought to the producing stage as rapidly as possible.

Within five or six years the Central African field may be producing as much copper as Arizona, and considerably more ten years hence. Beyond doubt six deposits that will make very large producing mines are in development there at present, and the output of Katanga will continue to be increased.

No essential to productive operations on a large scale is lacking—ore, capital, talent, coal, water and water power, and timber being available. Rio Tinto has taken an option on a large block of Southern Rhodesia Base Metals stock and will have that company's properties examined, probably with a view to equipping its Copper Queen and Copper King mines and making sulphuric acid from the pyrrhotite gangue of the ores for leaching the copper oxide ores of Northern Rhodesia.

Hudson Bay M. & S. to Smelt Sherritt-Gordon Concentrate

NEGOTIATIONS have been completed between Sherritt-Gordon and Hudson Bay Mining & Smelting for treating the copper concentrate from the former's mill at the smelter that will be built by the latter. Power needed for mining and concentrating at Sherritt-Gordon, which is on Cold Lake, in northern Manitoba, will be supplied by the Hudson Bay power plant at Island Falls, Saskatchewan. According to an announcement issued by Sherritt-Gordon, zinc concentrate from its 1,500-ton concentrator will be shipped to an electrolytic zinc plant which will be built in eastern Canada by Ventures, Ltd., and Consolidated Mining & Smelting. This confirms a previous announcement that such a plant would be built. No statement as to the site has yet been made, but the general belief is that it will be Sudbury. Blister copper from the Hudson Bay smelter, at Flin Flon, equal to the copper content in Sherritt-Gordon concentrate, will be shipped to the Ontario Refining plant, now being built at Sudbury.

North Fork Expects to Complete Flume in Fall

North Fork Placers at Helena, Calif., expects to complete its 12.8-mile wooden flume in September. The company intends to divert water from the North Fork of the Trinity River for placer and hydraulic mining. In the construction of the flume a sawmill was erected near the midpoint and lumber floated down for the construction of the lower part. Transportation on the upper portion of the flume is provided by a small "truck" constructed from the parts of a Ford touring car. The bottom width of the flume is 40 in. The car was cut down to an outside wheel width of 28 in. and operated on the finished floor of the flume delivering lumber to the construction end from the sawmill. A speed of less than 10 m.p.h. was necessary.

Build Mill at Piermone Mine, Near Ely District

EXCAVATION for the foundations of a 50-ton flotation mill and power plant has been started at the Piermone mine, at Spring Valley, Nev., near the Ely district. A 340-hp. Diesel engine will be installed to provide power. At the mill, the crushing department will consist of a Blake and a Symons cone crusher, each having a capacity of 240 tons. Minerals Separation flotation machines will be used. Two ore bins are being built, one at the mine having a capacity of 100 tons, and a mill bin having a capacity of 400 tons.

Management of the company estimates that there is blocked out in the mine 70,000 tons of ore carrying silver and gold. A 3,000-ft. tunnel cuts the 300 level. Electric haulage has been installed. A new shaft is being sunk to prospect another showing. The company has built two dormitories and nine new structures with hot and cold water and baths. A boarding house with a refrigeration plant will feed 50 men. The company also has a hydro-electric plant, assay and office buildings. A 2-mile pipe line has been built to supply the hydro-electric plant with water. E. W. Venable is general manager and L. W. Ehnboom, assistant general manager and engineer in charge of operations.

Cyprus Mines Orders New Electric Hoist

An order for a double-drum electric hoist has been placed with the Nordberg Manufacturing Company, of Milwaukee, by the Cyprus Mines Corporation, operating a copper property at Skouriotissa, on the Island of Cyprus in the Mediterranean Sea. This hoist will serve a vertical shaft which is now being sunk at the property and can operate to a depth of 900 ft. The hoist will operate in balance while hosting ore and both in and out of balance when hoisting men. It will handle 11,200 lb. of ore per trip, and the total weight will be about 20,000 lb. At first it will be driven by a 100 hp. Westinghouse motor and will have a rope speed of 150 ft. per minute, but later this motor will be replaced by a 150 hp. Westinghouse motor which will furnish a rope speed of 300 ft. per minute.

Resume Work at Alta Tunnel

Alta Tunnel & Transportation has resumed mining operations at its property in Big Cottonwood Canyon, near Salt Lake City, Utah. Ore is being mined on the 120 level below the Annie tunnel of the old Prince of Wales property, and on two other levels. Operations at the mill will be resumed as soon as the spring run-off of water has been completed. Concentrate made during the winter is being shipped. It assays about 160 oz. of silver per ton, 52 per cent lead, and 2 per cent copper.

Crew at United Verde Makes Remarkable Safety Record

The crew of miners shown herewith have just completed a full year's employment at the United Verde Copper Company's mine in the Jerome district of Arizona, without a single lost-time accident. This is equal to 10,095 man shifts. At the extreme right is Fred Selberg, shift boss. Safe practices pay dividends in more ways than one.

Howe Sound Starts Hoisting Ore at Santo Domingo Shaft

PRODUCTION from the Santo Domingo, or No. 5, shaft of the Potosi Mining unit of Howe Sound, operating in the Chihuahua district of Mexico, has been started. This ore will supplant production from the Calera Mining property, also owned by Howe Sound, which was permanently closed down at the end of May because of the exhaustion of the orebody. The 450-hp. hoist, formerly used at the No. 1 shaft of the Potosi unit, has been transferred and installed at the Santo Domingo shaft. Both of these shafts are being sunk to a depth of 3,000 ft., to develop important deposits of lead-zinc sulphide ore disclosed by diamond drilling. They have now reached the No. 17 level, or about 1,800 ft. below the surface. Installation of a new 750-hp. Allis-Chalmers electric hoist at No. 1 shaft was completed last February.

Shaft No. 3, which is also being deepened, passed through more than 50 ft. of lead-zinc sulphide ore between the No. 16 and No. 17 levels. This shaft is now near the No. 18 level. As development proceeds at depth in the various shafts, the orebodies are apparently increasing in extent. Operations at Potosi, it may be noted, were continued at regular rate throughout the recent revolution. The mill is now handling 1,500 tons of lead-zinc ore daily as a result of remodeling. No new equipment has been added to plant since a Symons cone crusher and two additional Minerals Separation flotation cells were added to bring the capacity from 1,200 tons daily up to 1,500 tons.

Unwatering of the workings at the San Rafael and Eden properties, in the city of Zacatecas, will be undertaken as soon as some geological examination and surveying work now under way is finished. Probably another year must elapse before this preliminary exploration work is completed and the properties put in condition for production.

Operations at the property of Britannia Mining & Smelting, the company's subsidiary in British Columbia, are being maintained at the rate of about 5,000 tons mined and milled daily, with a copper production of about 3,500,000 lb. monthly. Development of the Bluff West deposit, the newest orebody opened up at Britannia, is satisfactory.

At the three properties the company has under option in the Northwest—the Toric mine, near Alice Arm, B. C.; the Kootenay King, near Fort Steele, B. C.; and the Holden, near Lake Chelan, Wash., which was formerly owned by Chelan Copper—working crews are now actively engaged in development, checking results submitted, and attempting to extend the known orebodies. This work will be continued till the end of the present open season.

Quartz Hill Reopening Gilpin County Mines

QUARTZ HILL CENTRAL MINING is reopening its properties on Quartz Hill, in Gilpin County, Colo., which have been idle for the last 30 years after having produced about $1,500,000, according to H. E. Davis, mining engineer, of Denver. Since January, the company has equipped the property with electrically-driven hoisting and compressor machinery, has unwatered the workings and has reclaimed the Egyptian shaft, 800 ft. deep. Repair work is now being done on the crosscut at 700 ft. A drift will be driven along the vein at 800 ft. also. Shipments from previously developed orebodies are expected to start in July. Drainage is provided through the Argo, or Newhouse, tunnel, which cuts the property at a depth of 1,750 ft.

Mayflower-Old Colony Hits 15-Ft. Vein at 1,700 Level

MAYFLOWER-OLD COLONY has a showing of copper in the amygdaloid vein in which it started drifting recently from the 1,700 level crosscut 3,578 ft. from the shaft at its property in Michigan. The mineralization is the most encouraging encountered in years. The ground is regular, there being no evidence of faulting. The vein is 15 ft. in width. The drift is proceeding south on the hanging side. Later, the bed also will be opened to the north. The ore appears to be in the foot wall, the copper being in crevices in the form of flat or sheet mass.

Because of the great length of the crosscut from the shaft and difficulty of ventilation, drifting and crosscutting will be done alternately, a week of drifting to be followed by a week of crosscutting. The crosscut will not be extended to the boundary of the property at this time, the present objective being an additional 150 ft.

If the copper showing continues, it is estimated that the company would have at least 7,000 ft. on the dip of the lode, considering the depth of the crosscut and the remaining distance to the boundary.

Equip Pacific Gold Mill to Treat by Flotation

Equipment of the Pacific Gold mill with Fagergren flotation cells is expected to be completed about July 1, and the plant will start handling ore from the dump and the mine at the head of American Fork Canyon, 50 miles from Salt Lake City, Utah. About 1,000 tons of mill-grade ore is on the dump. Most of the ore mined heretofore has been taken from the quartzite formation.

Ontario Mining Association Meets at Noranda

REPRESENTATIVES of practically every producing mine in northern Ontario attended the annual meeting of the Ontario Mining Association at Noranda, in the adjoining province of Quebec, on June 20. J. Y. Murdoch, president of Noranda Mines, presided over the meeting. Charles McCrea, Minister of Mines for Ontario, delivered the opening address in which he stressed the necessity for co-operation between operators and the government.

A lengthy discussion on the proposed mining act followed, particularly in regard to the responsibility of officials for accidents. Oliver Hall, of International Nickel, stated the general opinion when he declared that the highest and lowest officials should share in the responsibility. J. C. Nichols was elected president for the year, F. D. Reid was elected first vice-president, D. L. H. Forbes was elected second vice-president, and G. C. Bateman was elected secretary. On the second day of the meeting, the members were taken through the Horne mine of Noranda Mines, and also the company's smelter.

Will Spend About $300,000 at Two Nevada Gold Mines

BETWEEN $300,000 and $400,000 will be spent by the Betty O'Neal and Gold Circle Consolidated companies for development of their properties at Battle Mountain and Midas, Nev., respectively, according to Nobel Getchell, who is manager of both. A 350-gal. station pump will be installed at the Elko Prince mine of Gold Circle, as well as a 350-gal. centrifugal sinking pump. A 400-hp. Fairbanks-Morse Diesel engine will be added to the power plant and an additional 1,200-cu.ft. Sullivan air compressor will be used.

At the Betty O'Neal property a diamond drill will be added for exploratory work. A selective flotation plant will be built at the Cash mine, in Arizona, which is controlled by Gold Circle, to recover the copper and zinc content in the tailing. This property has been treating ore by amalgamation and concentration, and the base metals have consequently been lost.

Resume Operations at Mine Near Pike, Nev.

Operations are to be started at once in the property of Caliente-Cobalt Mining, 4 miles from Pike, Lincoln County, Nev., under the directions of W. J. Lawrence of Salt Lake City, Utah. The formation is a limestone-shale-quartzite rock, similar to that in the Pioche district. Numerous east-west crossbreaks and several igneous dikes cut northeast-southwest fissures. Some production of gold, silver and lead has come from the three shafts and two short tunnels in the property.

Mason Valley Closed Nevada Property Last Week

ON June 22, Mason Valley Mines closed its mine and flotation plant at Thompson, Nev. The smelter had been closed since April 1. The Bluestone sulphide orebody has been exhausted and at the Mason Valley mine, the material is largely junore, which would require larger amount of capital to exploit than is justified. Closing of the Mason Valley properties was delayed as several parties were negotiating for the purchase of the mine, 1,200-ton flotation plant and smelter. Closing of the smelter leaves Nevada without any smelting plant except the Nevada Consolidated unit at McGill, in the extreme western part of the state.

Hearing on Graphite Duty Held at Washington

BOTH producers and importers of graphite presented arguments on the tariff at the hearing by the Senate sub-committee at Washington on June 21. A plea for a duty of 5c. per pound on crystalline lump, chip and dust graphite, and on crystalline flake graphite was made by Representative Patterson of Alabama, on behalf of domestic producers in that state. The present duty on lump is 20 per cent ad valorem and on flake 1½c. per pound. The duty on lump is increased to 25 per cent and the duty on flake is cut to 1¼ cents per pound by the House bill.

In answer to repeated questions by Senator Edge, chairman of the sub-committee, Mr. Patterson said that during the war domestic graphite apparently was found to be satisfactory. He expressed the opinion that the preference exhibited for imported graphite since then is due primarily to the lower price. Senator Edge remarked that wartime necessity was hardly a fair measure by which to judge. Senator King, a member of the sub-committee, asserted that the demand for a 5c. duty is too high.

W. L. Shumate, of Alabama Quenelda Graphite, Birmingham, insisted that unless the graphite industry is given adequate protection it will go out of existence. He said that the industry had asked for 6c. a pound duty in 1921 and that the duty of 1½c. per pound provided by the 1922 act has proved to be totally inadequate.

Dr. T. P. Maynard, industrial geologist of the Atlanta, Birmingham & Coast Railroad, which traverses the graphite territory in Alabama, stated that domestic resources of domestic graphite are ample and are suitable for all purposes. Elimination of the tariff on graphite was urged by J. H. Schermerhorn, of the Joseph Dixon Crucible Company, Jersey City, on the ground that the domestic crucible industry is in urgent need of relief. He insisted that regardless of the measure of the tariff, Ceylon graphite must be used in crucible manufacture. Questioned by Senator King regarding artificial graphite, he said that it is not used in crucible manufacture but that it has developed many uses which never were supplied by the natural graphite.

H. M. Riddle, Jr., of Asbury, N. J., representing graphite grinders and refiners, declared that the tariff proposed by the domestic producers would be of no benefit to them but would penalize manufacturers and consumers who would be forced to continue to use the foreign product.

Will Start Black Mammoth Mill About July 10

Black Mammoth expects to start its new 50-ton silver-gold mill at the Mary mine, near Silver Peak, Nev., about July 10. All the machinery except the Dorr classifier has been delivered. Included in the equipment is a 12x15-in. Blake rock crusher, an Allis-Chalmers gyratory crusher, a Hardinge ball mill, a 10-ft. Dorr classifier, an 18-ft. K. & K. flotation machine, a Wilfley pilot table and a Wilfley concentrating table. Albert Silver, who designed the Belmont Development mill and who is preparing plans for the new Gold Hill mill, designed the Black Mammoth plant. About 12 tons is being shipped daily to the Fanchini mill at present.

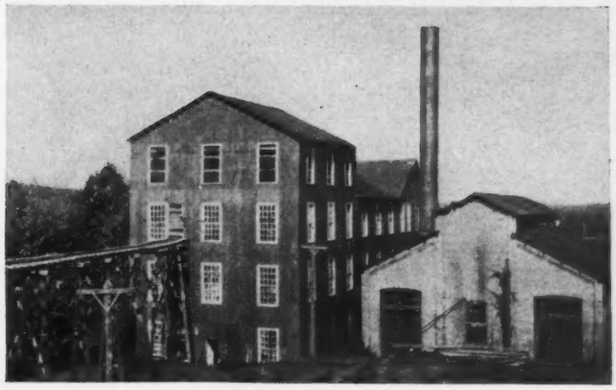
Report Gold Rush in Lower California

A new gold rush is reported in Lower California, Mexico. Within the last three weeks scores of placer locations have been made on the old Alamos diggings, in the Ensenada district. Several applications have been made for exploration and exploitation in the district. Most of the capital is coming from southern California.

The local government in Lower California is extremely friendly to the mining interests and is doing everything possible to stimulate the industry in the northern districts.

Prove Ore for 800 Ft. on 400 Level of Constitution

Ore had been proved for a length of 821 ft. on the 400 level of the Constitution mine, in the Coeur d'Alene district, of Idaho, up to May 31, according to William P. White, general manager of the property. The north drift on the 400 level has been advanced 781 ft. from the shaft crosscut. Since June 1, drifting has continued and the face of the drift is now in good ore about 5 ft. wide. The main shaft is now 156 ft. below the 400 level. Operations at the mill are on a one-shift basis.



Headframe of the main shaft of the Howie mine, in Union County, N. C., at the left. At the right is shown the milling plant which has just been electrified.

Completely Electrify Howie Mine, in North Carolina, for Resuming Operations

By Claud Hafer
Mining Engineer, Southern Pines, N. C.

PREPARATIONS are now being made to resume mining and milling operations at the Howie mine, owned by Jackson Gold Mining and located near Waxhaw, Union County, N. C. The Howie is one of the oldest mines in the state. Work has been carried on intermittently since before the Civil War, and two different mills have been built at the property. Recently the main shaft was retimbered and unwatered to a depth of 355 ft., and development will soon be started underground. The entire mechanical plant will be electrified and current will be taken from one of the large hydro-electric power producers supplying the region.

Part of the new machinery is on the ground and is being installed. It includes a 1,190-cu.ft. Ingersoll-Rand compressor, driven by a 200-hp. General Electric synchronous motor. An Ingersoll-Rand drill sharpener for 1-in. and 1¼-in. steel, an oil furnace, and several new Ingersoll-Rand Jackhamers and drifters will be added. The Flory double-drum hoist will be connected to a 50-hp. General Electric slip-ring motor, with reversing drum control and grid resistance. A five-stage Hill centrifugal pump, direct-connected to a 60-hp. Allis-Chalmers electric motor, will handle the flow of water from the mine, which is about 240 g.p.m.

At the mill a 125-hp. Westinghouse slip-ring motor will furnish power for stamps, tube mill, classifiers and pumps, a 40-hp. General Electric motor will operate the Gates crusher, and a 15-hp. Westinghouse motor will run the thickeners. A 450-kva. General Electric transformer, ample for 500 hp., supplying both 440-volt and 220-volt current for the mine pump, has been delivered.

Ore occurs here in a mineral zone, said to be 400 ft. wide, and opened by shafts and cuts for a distance of a mile. Country rock is a dark schist, usually highly silicified and striking north 55 deg. east. Conforming to the strike are numerous veins of variable width. Cutting the schist and the orebodies are several diabase dikes, with a northwest strike. Both ore and wall rock contain some pyrite at depth. The ore is apparently schist with interlaminated quartz stringers. Gold occurs as films in the schist planes and along the contact with the quartz stringers.

The main shaft is 8x18 ft., with three compartments. Levels have been driven at 150, 250, and 350 ft. below the collar of the shaft. Stoping will be started on the Clark orebody near the shaft. This orebody, as well as the Bullface shoot, which is nearby, has been explored and mined on all three levels. On the second level, a drift to the southwest will be continued toward the Pansy shaft, where an oreshoot has been opened that contains coarse gold. This drift is now 180 ft. from the line of the Pansy shaft, which is only 104 ft. deep, and will pass about 150 ft. below it. Total area of the mine is 253 acres. The company also owns the Bonnie Belle mines, about 2½ miles away, which will be operated at the same time.

Transportation from mine to mill is by means of an 800-ft. track. Cars dump into a 75-ton orebin that feeds a No. 4 Gates gyratory crusher, which reduces ore to ½ in. By a belt and bucket elevator, the ore is then lifted to the 200-ton mill bin. From there, the ore goes by gravity to four batteries of Allis-Chalmers stamps, 850 lb. each, which stamp in solution to 30 mesh.

From the stamps the pulp flows to a Chalmers-Williams 5x16-ft. scoop-feed tube mill, working in closed circuit with a Dorr drag classifier, which returns everything over 200 mesh to the tube mill. Further treatment includes agitation in a Dorr agitator and thickeners. Slime is discharged from No. 5 thickener without filtering. Precipitation of gold-bearing solution is by zinc dust.

The practice described is that used when the mill was last operated in 1925.

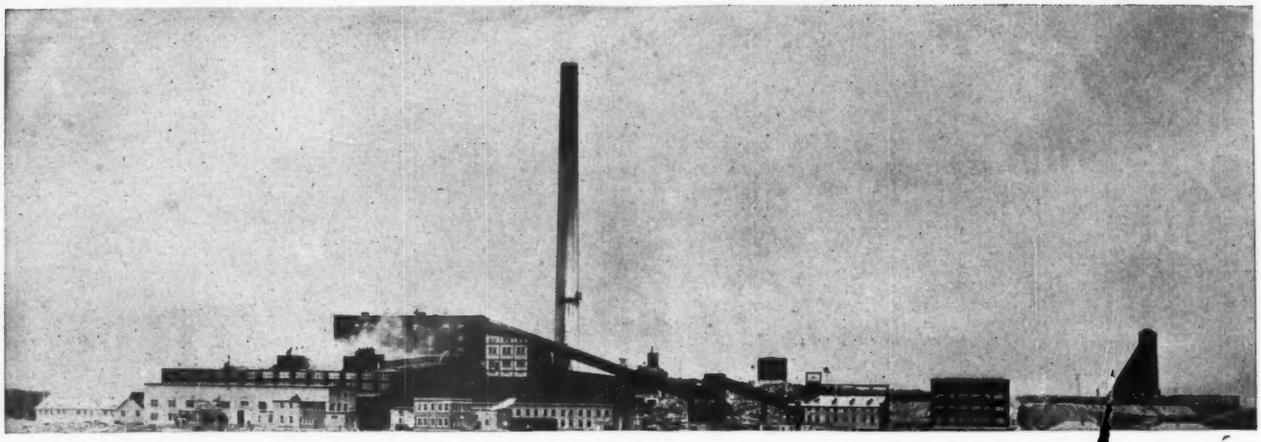
L. Barnett Newby is general manager, Charles E. Wyatt is at present in direct charge of the property, and R. W. Tysinger, who has been on the property for more than twenty years, is mine foreman.

Enlarge Power Plant and Mill at Old Dominion

ADDITIONS are being made to the power plant and the copper concentrator at the Old Dominion property, at Globe, Ariz. A new 2,250-hp. Nordberg Diesel engine will be added to the power plant, which now consists of two 1,250-hp. units of the same make. Phelps Dodge, which is interested in Old Dominion, is the largest Diesel-power user in the country. Capacity of the concentrator is being increased about 400 tons daily to a total of 1,600 tons. Concentrate from this plant is shipped to the International smelter, at Miami, as the Old Dominion smelter has been closed for several years. Both Old Dominion and Arizona Commercial ores are treated at the Old Dominion mill. The increase in the capacity of the concentrator is to make possible the treatment of a larger amount of low grade ore so as to maintain production of copper, as very little higher grade ore has been developed recently.

Seneca Using Flotation

Seneca's one stamp head that is in commission is operating with flotation methods at the mill in the Michigan district. Another head will be similarly equipped and will be in readiness when needed. Good copper ore continues to come from the bottom levels of No. 1 shaft, the No. 3 level north drift. and the No. 18 level of No. 2. The No. 3 level drift now is breasted 800 ft. north of No. 2. Sinking to the 10th level is under way in No. 1. The shaft is going down in the footwall. After the No. 10 level is reached, a plat will be cut and a crosscut driven to the vein, a distance of 85 ft.



The Noranda smelter, in the Rouyn district, which region will be the center of geological investigation this summer

Six Parties Investigating Mineral Resources of Quebec

SIX parties of geologists are now scattered over Quebec, in Canada, tackling one of the most important surveys of mineral lands ever undertaken in the dominion. The survey parties have been organized by John A. Dresser, of Montreal. Two of the groups are busy in the Abitibi region, one group is in Chibougamau, one on the north shore of the St. Lawrence, and two parties are in the Gaspé peninsula, each party being in charge of a well-known geologist especially fitted for the particular work of the district.

Since the first discovery of valuable metals in northwestern Quebec, according to Mr. Dresser, the Minister of Mines has taken many important steps to benefit the mining industry of the province, including large grants for roads, subsidizing of boat services, and assisting railway extensions, besides maintaining the Bureau of Mines to which the new division is an adjunct. The work of the present year will be centered on the districts of Abitibi, Chibougamau, and the north shore of the St. Lawrence.

In the district of Abitibi, or Rouyn, a production value of $1,000,000 a month is expected this year. Shortly after the discovery of Noranda, a series of gold and copper deposits was found in Bousquet, Tadillac, Malartic, and other townships, which has been under development for several years. These deposits will be studied in detail. The gold-copper belt is in the claylands and apparently continues eastward from the vicinity of Rouyn to the Bell River. Investigation should disclose how far these conditions actually exist.

Near Cadillan and Malartic, two parties will make detailed studies of orebodies. These parties will be in charge of Prof. Alexander MacLean, of Toronto University, and Leslie V. Bell, known for his geological work at Boston Creek, Kirkland Lake, and elsewhere in northern Ontario.

In Chibougamau a party will explore under the direction of Joseph A. Retty, graduate of the University of Ottawa and Princeton University. On the north shore of the St. Lawrence, (Côte Nord), a study of resources will begin at the Saguenay River and will be continued northward and eastward. This work is

JOHN A. DRESSER

in charge of Dr. Carl Faessler, professor of mineralogy and geology in L'École Supérieur de Chémie, Laval University, Quebec.

In Gaspé two fields of operation will be undertaken adjoining the lead-zinc fields, which have been exploited by Federal Zinc & Lead, Huronian Belt, and other companies, and exploration and mapping will be carried on by Dr. I. W. Jones, author of several reports for the Geological Survey of Canada. His work will be largely in the Township of Richard. Occurrence of zinc-lead ores has been known publicly for twelve or fifteen years, through the work of Federal Zinc & Lead and reports of the Quebec Bureau of Mines and the Geological Survey of Canada. The interior of Gaspé, however, remains a large area still little known. Copper ores are also known in the eastern part of the peninsula.

Mr. Dresser, organizer of the parties, is a native of Richmond, Quebec, and a former lecturer in geology at McGill University, Montreal. For ten years he was with the Geological Survey of Canada and for the last fourteen years has been engaged in consulting work in Montreal. His activities have included studies in the Peace River country of British Columbia, and investigations for the Canadian Pacific Railway throughout its system, besides many examinations of mineral deposits in various parts of Canada and the United States. He is past president of the Canadian Institute of Mining and Metallurgy and of the Geological Section of the Royal Society of Canada.

Locke Brothers Released on Bail Pending Appeal

The Locke brothers and George Shurtleff, stock promoters who were convicted recently of attempting to defraud through the mail in connection with Canario Copper, have been released on bail, pending trial of the appeal from the decisions handed down against them. They had been sentenced to serve terms in the federal penitentiary at Atlanta. A point of interest in this connection is the fact that George Graham Rice, who was recently convicted for his activities with Idaho Copper stock, is still out of jail pending his appeal.

Moscow Silver Preparing for Shaft Sinking

Equipment for sinking the shaft at Moscow Silver, near Milford, Utah, will be installed during the week of July 4, when the mine will be shut down to permit this work. The shaft will be deepened to 1,700 ft. Shipments from the new strike on the 1,565 level have been made regularly, one carload lot netting the company about $2,900 after railroad and smelter charges.

Nordberg Hoists in New York Tunnel Construction

Sixteen Nordberg hoists have been ordered for the removal of rock through the sixteen shafts to be sunk to connect with the proposed 16-ft. tunnel (C, No. 2) to be constructed by the New York Municipal Board of Water Supply. In the description of this enterprise, published on pp. 920-21 of the issue of June 8, a hoist of the wrong type was inadvertently pictured.

MARKET AND FINANCIAL NEWS

Year Ended March 31, 1929, Sets Operating Record for McIntyre Porcupine

McINTYRE PORCUPINE MINES, Ltd., report for the year ended March 31, 1929, shows that the results obtained constitute a record in the history of the company's operations. Production and tonnage treated were slightly in excess of anything previously recorded, and the estimated ore reserves were larger at the end of the year than they were at the beginning.

Production during the period under review amounted to 202,421 oz. gold and 49,081 oz. silver. Dividend disbursements amounted to $798,000 during the period, or at the rate of $1 per share annually.

Profit and Loss Statement

Earnings:			
Bullion recovery			$4,212,624
Operating Costs:			
Mining and development	$1,626,125		
Crushing and conveying	73,483		
Milling	372,347		
Miscellaneous camp costs	64,336		
		$2,136,293	
Administrative and General Expense:			
Management and general expense—mine	$83,805		
Administrative and general expense, Toronto office	81,224		
Transfer, registrar, stock issue, and dividend expense	8,127		
Insurance	15,461		
		188,619	
Total operating costs before providing for taxes and depreciation			2,324,912
Operating profits before providing for taxes and depreciation			$1,887,712
Non-Operating Revenues:			
Interest and discounts earned		$125,365	
Miscellaneous earnings		5,390	
			130,755
			$2,018,468
Appropriations:			
Provision for municipal, provincial and dominion taxes for current year			115,154
Net profit for the year before depreciation provision—transferred to surplus account			$1,903,313

HECLA MINING COMPANY reports the results of its operations for the last two quarters as follows:

The company recently announced an increase in its quarterly dividend rate from $0.15 to $0.25 per share.

	a1928, Fourth Quarter		1929, First Quarter
Gross income	$874,649		$981,306
Operating expenses	$362,720	$376,254	
Taxes accrued	57,961	85,500	
Depreciation	24,684	26,514	
Total expenses	445,366		488,268
Net profit	$429,282		$493,037
Tons mined	76,587		82,235
Pounds lead produced	14,375,049		15,068,653
Average lead price	$6.51		$7.16
Pounds zinc produced	.....		162,476
Average zinc price	.....		$6.50
Ounces silver produced	401,248		419,333
Average silver price	$0.57		$0.56

(a) Certain non-recurring adjustments eliminated.

Expenditures by Non-Dividend Paying Coeur d'Alene Mines Increased in 1928

ACCORDING to Ravenel Macbeth, secretary of the Idaho Mining Association, the 1928 mining expenditures, in the Coeur d'Alene district, of the non-producing development companies and the producing non-dividend paying companies amounted to $4,721,467, compared with $4,494,745 expended in 1927 by similar companies, an increase of $226,722. There were 263 operating companies in 1928 that employed 1,323 men. Report of 1928 expenditures follows:

Non-Producing Development Companies

Labor	$801,907
Supplies	297,080
Mine equipment	69,970
Mill equipment	6,700
	$1,175,657

Producing Non-Dividend Paying Companies

Labor	$1,605,460
Supplies	1,711,400
Mine equipment	81,720
Mill equipment	132,980
Ore transportation	14,250
	$3,545,810
Coeur d'Alene district total	$4,727,467

COMPAÑIA MINAS DE GATICO owning a copper mine and smelter near Tocopilla, Chile, operated at a loss of 1,376,662 Chilean pesos in 1928. The smelter was started on April 3, 1928, and much trouble was encountered at first. During the rest of the year, a total of 40,647 tons of charge was treated, from which 2,753 tons of copper was produced. Gold output was 1,910 oz. and silver production was 11,350 oz. Production from the company's Toldo mine was 27,981 tons of copper ore of an average grade of 6.5 per cent copper. On Dec. 31, 1928, reserves were estimated at 149,222 tons of ore, of an average grade of 3.95 per cent copper. Production from the Michilla mine was 12,382 tons of an average grade of 6 per cent. Reserves at this property are roughly estimated at 250,000 tons of ore of 6 per cent copper, and about 250,000 tons of lower-grade material for which no percentage is given.

THE VIPOND MINE, of Porcupine, during the three months ending April 30, 1928, treated 26,357 tons and recovered $209,500, an average recovery of $7.95 a ton. Development work has been continued in the new orebody and good ore has been disclosed on the 4th, 5th, 6th, and 7th levels. At present a considerable amount of diamond drilling is being done on the 1,000 level in addition to work on the 200 level in an effort to find a continuation of the Hollinger No. 97 vein.

CALLAHAN ZINC - LEAD COMPANY, operating in the Coeur d'Alene district, Idaho, submits the following report of operations at its Galena mine in the first quarter of 1929:

Earnings		
Net value of shipments	$11,040	
Interest earned on bonds	4,442	
Profit on sale of securities	1,418	
Total earnings		$16,901
Costs and Expenses		
Development costs at galena mine	$27,148	
General and administrative expenses	11,989	
Maintenance costs at Interstate property	3,335	
Total costs and expenses		$42,473
Deficit for period		$25,571

Note—Included in the general and administrative costs for this period is the sum of $8,431, balance of attorney's fee due for settlement of the government claim for taxes. This closes all expense in connection with this settlement.

AMPARO MINING COMPANY reports a loss on its Mexican operations of $99,655 in 1928. A total of 87,533 metric tons of ore was milled during the year, for which the average cost per ton was $1.935. Production during the year amounted to 251 kilos gold and 13,502 kilos silver.

Lucky Tiger Earned $458,632 in 1928

LUCKY Tiger-Combination Gold Mining Company produced, from the Tigre mine in Sonora, 9,683 oz. of gold and 2,599,485 oz. of silver in 1928 compared with 11,484 oz. gold and 2,549,186 oz. silver in 1927.

Consolidated income account for 1928 follows:

Gross Operating Income:			
From sale of ore and concentrate			$1,897,456
Deduct:			
Cost of operation			1,390,952
Net operating income			$506,504
Income from other sources:			
Interest on United States securities and bank balances	$56,218		
Mercantile store profit	12,231		
Miscellaneous income	17,599		86,049
			$592,554
Deduct:			
Administrative expenses in United States	$37,634		
Exploring and examining new properties:			
In United States	55		
In Canada	40,870		
In Mexico	1,614		42,540
Fire insurance covering subsidiary companies	1,320		
Hospital deficit incurred	54		
Depreciation of office equipment, Kansas City	198		
Provision for income tax, 1928:			
Domestic corporation:			
United States federal tax	$17,901		
State tax	33		
Foreign corporations:			
United States federal tax	43		
Mexican federal tax	34,190	52,168	133,916
Net income from realizations for 1928			$458,637
Deduct:			
Adjustments applicable to year 1927—net			5
Surplus from realization 1928			$458,632

Note—The Tigre Leasing Company, S. A. (90 per cent owned) is not included in this statement. The operating income for 1928 was $3,158. After providing for depreciation, amortization and legal reserve of $5,017 the net deficit was $1,859.

COMPAÑIA MINERA Y AGRICOLA OPLOCA, operating a tin mine in Bolivia, reports profits of £131,143 in 1928, as compared with £180,259 in 1927. This decrease resulted entirely from the drop in the price of tin, as working costs were reduced from 47.33 Bolivianos per quintal of tin produced to 38.18 Bolivianos per quintal. Production increased from 85,800 quintals to 103,510 quintals, recovered from 72,851 tons and 79,474 tons of ore treated, respectively. Reserves at the end of 1928 consisted of 144,618 tons of 5 per cent ore and 74,359 tons of 2 per cent ore.

CONIAURUM MINES, LTD., bondholders had deposited their holdings to an amount in excess of $720,000 on Friday, June 21, the minimum which was necessary to make effective the agreement whereby Ventures, Limited, takes over control of the property, according to a recent announcement. Coniaurum Mines, Ltd., sponsored by Coniagas Mines, Ltd., of Cobalt, has developed the amalgamated Newray, Goldale & Armstrong-Booth claims in the Porcupine district, Ontario, to a depth of 2,000 ft. Plans for further development include extending operations to greater depths. This may be done either by sinking a winze to a depth of 3,000 ft. from the 2,000 level near the Armstrong-Booth-Goldale line, or by making an arrangement with McIntyre-Porcupine Mines, Ltd., to allow development to be carried on from the east drift at the 3,875-ft. level of McIntyre. Hollinger, McIntyre and Coniaurum occupy locations along the strike of the main ore zone of the Porcupine camp. As it is well known that McIntyre is getting some of its best ore at depth due to the rake of the Hollinger orebodies eastward, Coniaurum has possibilities of picking up the extension of McIntyre orebodies between 3,000 and 4,000 ft., and possibly at greater depths.

CALAVERAS CEMENT COMPANY operating a cement plant at San Andreas, Calif., has placed 7,500 shares of 7-per cent cumulative preferred stock, carrying with it the same amount of common stock, upon the market through several brokerage firms who have underwritten the issue. Balance sheet of company shows a surplus of $540,000 and earnings applicable to common stock in 1928 are given as $3.90 per share.

ELECTROLYTIC ZINC COMPANY OF AUSTRALIA LTD., at Risdon, reports production for the four weeks ended April 3, 1929, compared with the two previous periods as follows:

	Period Ended Feb. 6	Mar. 6	Apr. 3
Zinc, tons	3,849	3,909	3,901
Used at the works, tons	65	60	60
Silver-lead, product for shipment to Port Pirie for realization, containing			
Lead, tons	565	560	550
Silver, oz.	57,000	67,000	71,000

INTERNATIONAL NICKEL COMPANY, LTD., reports a substantially larger income in the first quarter of 1929 than in the first quarter of 1928, as shown in the following financial summaries:

Consolidated Profit-and-Loss Accounts

Three Months Ended March 31, 1928		
Earnings		$2,977,806
Other income		46,562
Total income		$3,024,369
Administration and general expense	$179,998	
Reserved for taxes	253,574	433,573
Net operating income		$2,590,796
Depreciation and depletion	$384,702	
Retirement system	98,174	482,876
Profit		$2,107,920
Dividends, Preferred	$133,689	
Common	836,692	970,381
Balance		$1,137,539
Three Months Ended March 31, 1929 (a)		
Earnings		$7,391,660
Other income		469,047
Total income		$7,860,708
Administration and general expense	$527,728	
Reserved for taxes	748,698	1,276,426
Net operating income		$6,584,281
Depreciation and depletion	$738,648	
Interest paid and accrued	104,251	
Retirement system	151,190	994,090
Profit		(b) $5,590,191
Dividends, Preferred	$589,876	
Common	2,749,146	3,339,022
Balance		$2,251,168

(a) Figures of The Mond Nickel Company, Limited, included.

(b) Equivalent to 36 cents per share on the common stock after allowing for preferred dividend.

Tonopah Mining Had Successful Year in 1928

TONOPAH MINING COMPANY, operating silver mines at Tonopah, Nev.; a gold dredge at Breckenridge, Colo.; a copper prospect in Nicaragua; the Vertex property near Silverton, Colo.; and holding a substantial stock ownership in Mandy Mines, Ltd., in Manitoba and Saskatchewan, Canada, presents the following income and surplus statement:

Surplus, Dec. 31, 1927			$2,616,291
Net Earnings and Income for 1928:			
Gross value of ore milled	$1,404,024		
Metal loss in milling and refining	105,391		
		$1,298,633	
Mining, milling and marketing expenses		1,086,141	
Profit from operations of mine and mill		$212,491	
Income from investments	$38,519		
Interest on loans	155,055		
Profit from sale of securities	19,731		
Miscellaneous income	3,468		
	$216,774		
Less: Bullion and internal revenue taxes, rental and sundry charges	53,582	163,191	
Net income for 1928		$375,683	
Deductions:			
Expenditures for examination of mining properties located in United States and Canada		31,765	
			343,917
			$2,960,208
Loss on sale of 835 shares of Tonopah & Goldfield Railroad Company preferred stock			41,700
			$2,918,508
Dividends paid			150,000
Surplus, Dec. 31, 1928			$2,768,508

A total of 71,561 dry tons of ore was milled producing 18,315 oz. of gold and 1,574,336 oz. of silver. Of the total tonnage 28,898 tons was produced from the company's mine, and 42,663 tons was custom ore.

DOME MINES, LTD., reports production for May of $409,518 from 147,700 tons, an average of $8.57 a ton. This is an increase of $48,000 compared with the next highest month in 1929. The May output, however, may be regarded as exceptional, as it was the result of a clean-up in the mill which recovered a large amount of free gold.

THE AMULET MINE, in Rouyn, Quebec, has now been assured of further financing, according to a recent report. Sufficient money will be provided to continue development work and to build a concentrator, through the issue of treasury shares. The company has 500,000 shares still in the treasury, and a group of directors and associates is willing to underwrite the stock at $1 a share. An offering will be made to shareholders in the form of rights, and the syndicate will undertake to take up any unsubscribed balance. At present the company has approximately $80,000 on hand.

London Financial News

By W. A. Doman,
Special London Correspondent

London, June 11, 1929—The continuation of the price of tin at a low level for so long a time has stimulated producers to endeavor to find a remedy. They have been engaged in this way for months, but until recently have not been united in their action. At the end of last week an appeal for co-operation was made through the press by several leading men in the industry. Since these are mainly British, the idea is that uniform views are possible. The industry, in fact, seems to have created its own difficulties by lack of organization. Nigeria, Malaya, Burma, and Siam, are all represented in the appeal, and associated with it are Australian and French interests. As the signatories are responsible for about 40,000 tons of tin oxide yearly, serious business is obviously intended. Costs of production at present do not allow substantial profits. At the recent Geevor (Cornwall) meeting, St. John Wynne, the chairman, announced that, in conjunction with Sulman & Picard, he was experimenting with a new process which, it was hoped would, tend to great economy in recovering tin. He also said the company could produce with the metal at a much lower figure before it would be inconvenienced as regards costs. Whether the Cornish mining companies will join the projected British Producers' Association is not yet clear.

Copper continues very much in evidence, and the best is being made of developments in Northern Rhodesia. Rhodesian Congo Border shares are exrights of £2, and are still quoted at 10⅞s. Rio Tinto which, as I have previously stated, has taken a substantial interest in more than one direction in Rhodesian copper, is issuing 50,000 new shares at £50, against the market quotation of £57¼, in the proportion of one in eight. That the company is doing profitable business is clear from the statement of the chairman that the dividend of 40 per cent can be maintained on the increased capital. Rhodesia Katanga reports that at the Kansanshi mine the dolomite reef which is being opened up on the 150 level has shown to date a good width and length of high-grade ore.

A conference of nickel-producing companies was held in Paris a few days ago, and it was pointed out that the development of the nickel industry has assumed such proportions that production does not keep pace with demand. Co-operation was suggested.

A scheme of price protection for Chilean nitrate of soda in Great Britain and Ireland is announced by the Chilean Nitrate of Soda Producers Association. Dealers must be "approved," and for stocks unsold on June 30 next will be able to claim an indemnity in cash.

Anaconda Copper Mining Company directors recently voted to call all of the first consolidated mortgage Series A sinking fund 6 per cent bonds and all of the convertible 7 per cent debentures outstanding. The amount of first consolidated mortgage bonds outstanding is $102,846,000, and convertible 7 per cent debentures outstanding total $1,276,000. Holders of 7 per cent debentures have rights to convert their debentures into common at the rate of one common share for each $65 principal amount of debentures up to ten days prior to date of call.

F. W. Bradley, president of Alaska Juneau, in response to inquiries regarding operations, stated recently that the profits of the company this year will probably be greater than in 1928, notwithstanding the fact that for the first five months of this year they were somewhat below the 1928 level. This condition is explained by the fact that fluctuating weather conditions are a variable factor and yield depends upon gold content of the different orebodies.

Utah Copper Company's report covering the first quarter of 1929 follows: The total net production of copper from all sources for the quarter is shown below, in comparison with the output for the fourth quarterly period of 1928:

	Net Pounds Copper Produced	Average Monthly Production
First quarter—1929	80,997,345	26,999,782
Fourth quarter—1928	85,911,474	28,637,158

The following tabulation shows the financial results of the company's operations for the quarter as compared with the previous quarter:

	First Quarter 1929	Fourth Quarter 1928
Net profit from copper production	$8,472,200	$8,256,227
Miscellaneous income, including gold and silver	1,057,214	1,001,370
Income from investments	1,640,262	1,181,179
Total income	$11,169,678	$10,438,777
Depreciation	307,274	260,299
To surplus	$10,862,404	$10,178,477

The average cost per pound of net copper produced, including depreciation of plant and equipment and all fixed and general expenses and after crediting gold, silver, and miscellaneous earnings, was 6.3c. compared with 5.6c. for the preceding quarter, computed on the same basis.

Kennecott Copper Corporation proposes to increase its capital stock by 253,125 shares in payment for 112,500 shares of the Chase Companies, Inc., with which it recently agreed to merge. The latter figure includes all of the issued and outstanding shares of the Chase Companies. The ratio of exchange is 2¼ shares of Kennecott for one share of Chase. Kennecott has no par value, but has been selling lately between $80 and $100 a share. The capital stock of the Chase Companies will be held by Kennecott at a value of $21,375,000.

Domestic Magnesium Sales in 1928

Sales of magnesium produced in the United States in 1928 amounted to 865,662 lb., valued at $779,674, compared with sales of 366,400 lb., valued at $441,700, in 1927, according to the U. S. Bureau of Mines. Eighty-four per cent of the magnesium sold in 1928 was in ingot form at prices ranging from 55 to 85c. a pound, and such sales increased 189 per cent compared with 1927. Castings, tubing and sheet, constituted the remainder. The average price of domestic ingot metal in 1928 was 66c. a pound, that of powder $1.51 a pound, and of castings $2.39 a pound.

Imports of magnesium metal in 1928, consisting mainly of powder, were 12,039 lb., valued at $11,890, compared with 7,131 lb., valued at $8,402, in 1927.

Mother Lode Coalition Discover No New Ore

Results of operations of the Mother Lode Coalition Mines Company for the year ended Dec. 31, 1928, were as follows:

Income Account

Operating revenue:		
Copper sold—17,900,850 lb. @ 14.887c		$2,664,966
Silver sold—80,663 oz. @ 56.474c		45,553
		$2,710,519
Operating costs:		
Mining and milling	$501,656	
Treatment, refining and freight	861,508	
Selling and delivery expense	78,214	
General expense	24,036	1,465,416
Operating profit		$1,245,103
Miscellaneous income from operations		1,158
Profit on metals sold		$1,246,261
Deductions from income:		
Interest paid	$13,260	
Taxes	196,152	209,412
Net proceeds of operations		$1,036,849

Ore mined amounted to 61,074 tons, averaging 11.72 per cent copper and 1.63 oz. silver per ton, giving a total copper content of 7,160 tons and silver content of 99,715 oz. Shipments to the smelter totaled 15,047 tons, containing 13,417,520 lb. of copper and 93,008 oz. of silver. Exploration work was continued throughout the year 1928, but no new orebodies were discovered.

Société des Mines de Bor annual report states that the company's production of copper rose to 15,080 tons in 1928, an increase of more than 2,000 tons over the 1927 output. During the year a survey of a new lower level of the deposits was begun. Smelting was carried out entirely by four water-jacketed furnaces, and the installation of a fifth furnace of high capacity was proceeded with toward the close of the year.

Port Stockton Cement Company, formed to develop a cement plant and quarries in Tuolumne County, Calif., has been given permission to sell 130,000 shares of preferred and 65,000 shares of "A" stock in units of two and one at $50 per unit.

Mining Corporation Had $153,078 Operating Profit

FINANCIAL results of the 1928 operation of the Mining Corporation of Canada are shown in the following tables:

Mines Account for 1928

Production	
Value of silver	$755,691
Value of cobalt	42,109
Other income	4,937
Dividend from Cobalt Reduction Company, Ltd.	1,363
	$804,102
Cost at mine	
Mining cost	$420,439
Milling and reduction	163,699
Freight, realisation, transportation and smelting	20,149
Administration and general	46,735
Profit at mines	153,078
	$804,102

Consolidated Profit-and-Loss Account for 1928

Income

By profit at mines	$153,078
Interest, exchange and profit on investments	2,139,024
	$2,292,102

Expenditures

To administration expenses in Toronto and London, including directors' and engineers' fees, salaries of staff, traveling expenses, rents, printing, stationery, advertising, telegrams, and municipal taxes	$124,514
Examination of prospects	41,886
Charitable subscriptions	4,357
Provincial government royalties, taxes, and commissions	26,368
Mining rights written down	1,600,000
Balance down	494,975
	$2,292,102

Surplus Account

By balance preceding year		$46,541
Net profit		494,975
		$541,516
Shares Cobalt Reduction Company, Ltd., written down	$25,000	
Written off plant	49,880	
		$74,880
Dividend No. 26, paid June 13, 1928		207,506
Dividend No. 27, paid Dec. 20, 1928		207,506
Balance carried to balance sheet		51,623
		$541,516

The estimated ore reserves in the Cobalt mines at the end of 1927 were 25,000 tons containing 700,000 oz. The gross silver content of mill-ore extracted during the year was 1,084,946 oz. and the reserves, at the end of the year were estimated at 25,000 tons containing 600,000 oz.

VIEILLE MONTAGNE COMPANY output during 1928 amounted to 110,000 metric tons of zinc, against 100,000 tons in 1927, according to the company's annual report recently issued. A big program of equipment modernization is being carried out, for the completion of which a loan issue is to be made during the present year. At Bergamo, mining development work has been continued, including provision for hydro-electrical power. In Sardinia appreciable economies are being secured by the development of mechanical transport. In Germany, the Borbeck plants are working under excellent technical conditions. The new roasting, super-roasting, and sulphuric acid works will be in operation before the end of the year; and the Bensberg mines have just been equipped with modern flotaticn equipment. A loss incurred in the German section during 1928 was largely accounted for by the cost of labor and fuel and the burden of social charges. In Belgium the reduction plant at Flone, entirely reconstructed, is capable of producing 25,000 to 30,000 tons of zinc a year with low production costs. At Moresnet, a plant has been erected to deal with refuse from the washing plants. During 1929 it is estimated that 60 per cent of the output at Baelen-Wezel will be obtained in the mechanical furnaces, resulting in a large saving of labor, and the installation of electric dust-recuperation plant will be of benefit. As regards the French properties, important installations are in course of construction at Port-de-Bouc for the roasting of blendes and the reception of ores destined for the Viviez works, where the production of electrolytic zinc will be developed further.

GRANBY CONSOLIDATED MINING, SMELTING & POWER CO., LTD., reports the results of operations of its properties for the first quarter of 1929, compared with the corresponding quarterly period for 1928, as follows:

Production and Costs

	First Quarter 1929	First Quarter 1928
Net pounds of copper produced	14,904,806	13,561,345
Average monthly production	4,968,269	4,520,448

The net cost per pound of copper produced, including all operating and general charges, after allowing credits for the precious metals and miscellaneous income, was 9.97c, compared with a cost of 9.65c similarly computed for the first quarter of 1928. Costs are exclusive of depreciation, depletion, and income taxes.

Financial

	First Quarter 1929	First Quarter 1928
Operating income	$868,639	$501,996
Miscellaneous income	71,725	51,609
Net income (before depreciation and depletion)	$940,364	$553,605

The net income above stated is equivalent to $2.09 per share of stock outstanding at the end of the quarter, compared with $1.25 per share for the corresponding quarter of 1928.

The Bonanza mine was opened up in February, and shipments of ore to the Anyox concentrator were started during the quarter.

COPPER RANGE COMPANY has purchased the White Pine Copper Company, a Calumet & Hecla subsidiary in Ontonagon County, in the Michigan copper district. Its bid at a public sale conducted in the village of Ontonagon was $119,000, as against $118,760 by Calumet & Hecla. The sale includes all real estate and assets of White Pine. Proceeds from the sale will be used to liquidate the total liabilities of White Pine, amounting to between $115,000 and $116,000.

DAYROCK MINING COMPANY, operating in the Coeur d'Alene district, Idaho, netted $142,647 on its operation in 1928.

Austria's Non-Ferrous Metal Position Reviewed

ACCORDING to C. Warwick Perkins, United States Vice-consul at Vienna, with the exception of aluminum, of which there is a large exportable surplus, Austria is dependent to a considerable extent on imports for its supply of non-ferrous base metals. During 1928 imports from the United States alone had an estimated value of $5,780,000, covering non-ferrous alloys of nickel, zinc, tin, copper, and lead. The Austrian production of crude and manufactured lead, as well as zinc, has shown a continuous upward trend in recent years, although only eight mines were in operation in 1928 compared with nine in 1926 and 1927. The 1928 output consisted chiefly of galena and zinc blende. The Bleiberger Bergwerks Union A. G. produced about 80 per cent of the year's output from its Bleiberg-Kreuth and Eisenkappel mines in the Federal State of Carinthia. Most of the balance was produced in the Federal States of Tyrol and Syrmia.

Production of lead and zinc ores in 1928 amounted to 130,000 metric tons, compared with 127,882 tons in 1927 and 124,288 in 1926. The output of lead concentrates increased from 8,421 tons in 1926 to 9,400 in 1928, and that of zinc concentrates from 2,275 tons to 4,500. This advance in production has been accompanied by a decline in the number of workmen employed, as a consequence of the smaller number of mines in operation. Austrian lead production has increased steadily since the war, but unsatisfactory prices prevented a noticeable advance in 1928.

Aluminum is the only non-ferrous base metal which is produced in Austria in sufficient amount to cover domestic requirements and leave considerable quantities for exportation. Foreign shipments during the first nine months of 1928 totaled 2,703 tons.

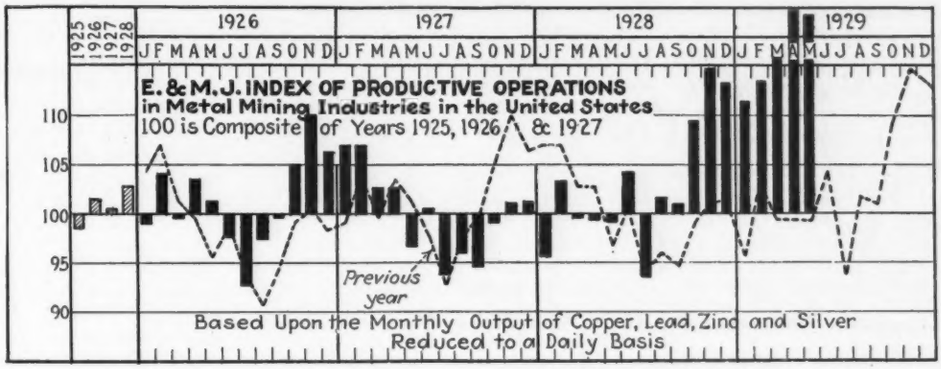
MOUNT LYELL MINING AND RAILWAY COMPANY LTD., reports the following results of ore treatment:

	Quarter Ended Sept. 30, 1928 Tons	Dec. 31, 1928 Tons	Mar. 31, 1929 Tons
Ore treated by mill	31,689	31,567	37,346
Concentrates produced	7,086	6,895	7,183
Mount Lyell ore smelted	180	19	421
North Mount Lyell ore smelted	1,159	724	1,145
Concentrates smelted	9,305	5,444	8,469
Total material smelted	10,644	6,187	10,035
Blister copper produced	2,297	1,215	1,901
Contents			
Copper, tons	2,274	1,204	1,883
Silver, oz.	41,592	19,825	29,692
Gold, oz.	624	370	662
Furnace ran, days	48	28	42
Cathode copper produced	1,731	1,819	1,707

KENNECOTT COPPER CORPORATION has declared a quarterly dividend of $1.25 per share on common stock payable July 1 to stock of record May 31. This places the stock on a $5 annual basis, as against a $4 basis previously.

Indicators of Industrial Activity

of Significance to Mining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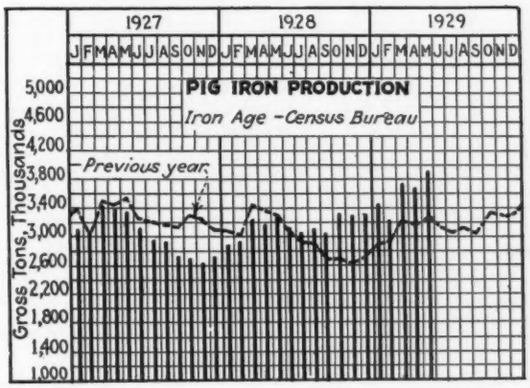
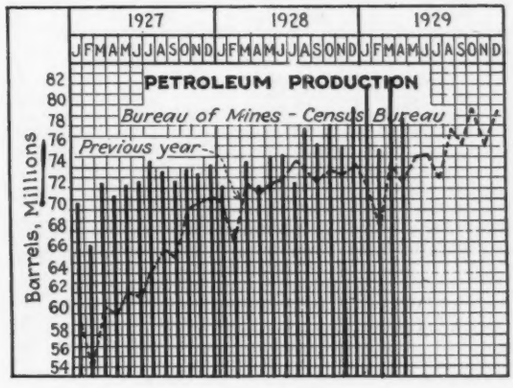
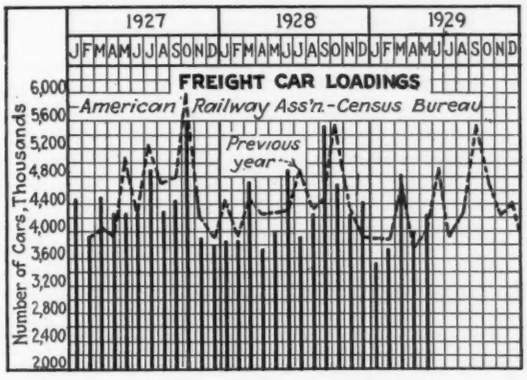
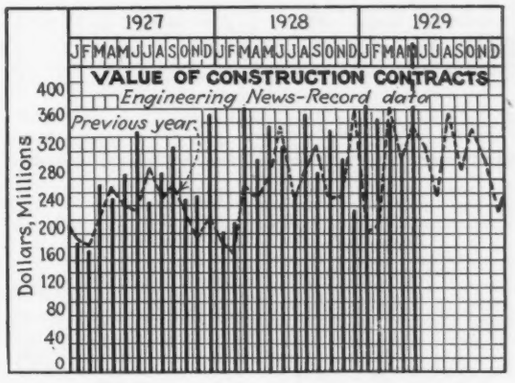
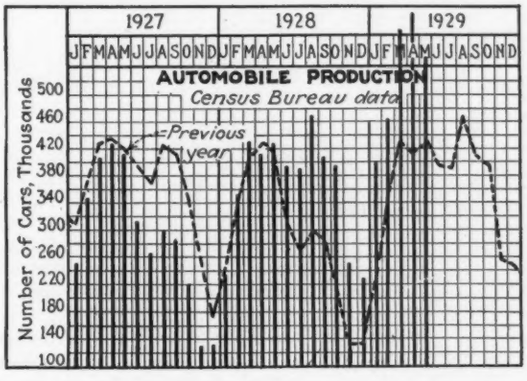
E. & M. J. INDEX OF PRODUCTIVE OPERATIONS
in Metal Mining Industries in the United States
100 is Composite of Years 1925, 1926 & 1927
110
105
100
95
90
Previous year
Based Upon the Monthly Output of Copper, Lead, Zinc and Silver
Reduced to a Daily Basis

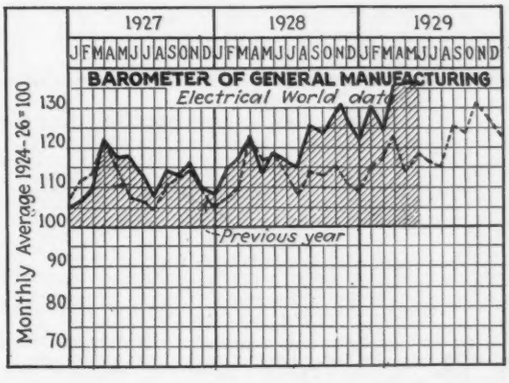












The Market Report

Copper and Lead in Fair Demand— Metal Prices Continue Stable

New York, June 26, 1929.—A three months' period of generally quiet metal markets, covering the second quarter of the year, has now been completed, with the belief general that manufacturers have practically exhausted their contracted supplies of metal and that therefore a more active metal market will be witnessed in July. Hand-to-mouth buying is about all that cautious observers expect, however. Since April 1, copper, of course, has declined 6c.; and tin is about 4c. lower, lead ¾c., and silver about 4c. Recently, however, all metal prices have been firm, and no weakness is visible in the immediate future for any of them. Producers do not seem to be impatient, and are content to wait for the demand to reassert itself.

Daily Prices of Metals

June	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
20	17.775	44.625	7.00	6.80	6.725
21	17.775	44.75	7.00	6.80	6.725
22	17 775	44.75	7.00	6.80	6.725
24	17.775	44.50	7.00	6.80	6.725
25	17.775	44.375	7.00	6.80	6.725
26	17 775	44.50	7.00	6.80	6.725
	17.775	44.583	7.000	6.800	6.725

Average prices for calendar week ending June 22, 1929, are: Copper, 17.775; Straits tin, 44.604; New York lead, 7.000; St. Louis lead, 6.800; zinc, 6.706; and silver, 52.625.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis; that is, delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted.

Quotations for copper are for the ordinary forms of wire bars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

June	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic bid	Spot	3M	Spot	3M	Spot	3M
	Spot	3M							
20	72¾	73	83¾	202	205½	23 15/16	23 13/16	26⅛	25 15/16
21	73 3/16	73⅛	83¾	202	205½	23 13/16	23⅝	26⅛	25⅞
24	73⅞	73 9/16	83¾	201½	205⅛	23¾	23⅝	26⅛	25 13/16
25	74 1/16	73¾	83⅝	200½	203⅞	23⅞	23⅝	26⅛	25¾
26	73 15/16	73 7/16	83¾	200⅞	204⅜	23¾	23½	26 3/16	25 11/16

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

June	Sterling Exchange "Checks"	Silver		Gold London	June	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
20	4.84⅜	52⅝	24 7/16	84s11½d	24	4.84 5/16	52¼	24¼	84s11½d
21	4.84⅜	52½	24⅜	84s11½d	25	4.84¼	52⅜	24¼	84s11½d
22	4.84⅜	52¼	24¼	.....	26	4.84¼	52¼	24 3/16	84s11½d

Average: Silver, 52.375c.; Sterling Exchange, 484.323c.

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of silver, 999 fine. London silver quotations are in pence per troy ounce of bar silver, basis 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

No Change in Copper

The volume of sales in copper continues well below normal, as it has throughout the last quarter, the total business done in the domestic market being less than a third of what it was in the first quarter. An improvement over last week was nevertheless recorded. The larger producers continue to turn business over to the custom smelters, except where certain shapes or brands are in demand, in which case they are selling small tonnages for immediate shipment. The custom smelters, however, are getting over three-quarters of the business. The price is uniformly 18c. for Connecticut deliveries, and 18⅛c. in the Middle West, with most of the demand from brass and wire mills for July and August shipment. A few hundred tons have also been booked for prompt and September.

The foreign demand has been fair, at 18.30c., c.i.f. usual European destinations. The June total of export sales will be well beyond that of April and May, though only about half of what was sold in March. Foreign buying has not increased as much, following settlement of the reparation problem, as was expected, but promises gradually to improve.

Fair Lead Activity

Demand for lead has abated slightly in the last week. Volume of sales reported to *E.&M.J.* amounted to slightly more than 95 per cent of an average week compared with 160 and 120 per cent of average in the two preceding weeks. Much of the business continues to be accounted for by small lots and carload shipments for nearby delivery. A fair diversification of orders among the various consuming industries is reported, with one important exception—the lead-covered cable manufacturers. Most producers look for buying in volume from this group to appear in the next few weeks.

Prices have been maintained with unusual consistency at 7c. New York, which is the A. S. & R. contract price also, and at 6.80c. East St. Louis. One or two sales of corroding lead were consummated on a basis of slightly less than 6.80c. but these transactions were offset by sales at slightly above the 6.80c. basis, at least one of which was made to a speculative interest. On the other hand several lots of resale lead for immediate shipment have been available in the Middle West at slightly less than 6.80c. since Monday of this week. These offers are quite generally looked upon as forced sales, however, and are considered of negligible importance as market factors. London quotations continue disappointing to domestic pro-

ducers who have expected more optimistic news from that direction. Today's London quotation for spot lead figures out at a discount of approximately $1 per ton under the 7c. per pound New York price.

Zinc Working Closer to 6.80c.

Only a few hundred tons of zinc has been sold in the last week, but the price is working up to the level quoted by most producers, 6.80c., St. Louis. Based on statistics of unfilled orders, they expect a good demand to manifest itself within the next two or three weeks. Zinc has been obtainable at 6.70c. all week, but in some instances a little more than this has been paid by old customers of the sellers; at least one lot brought 6.80c. High-grade is nominally 8c., delivered in the East for spot carloads.

Tin Market Unsettled

On June 20, an excellent consuming demand for tin was in evidence. With that exception the market has been without interest and the price trend has been generally downward until today, when support from the London group occasioned a slight stiffening in prices. The recent weakness is largely attributable to the fact that stabilization by London interests is now an old story. A good proportion of the consuming demand was for forward positions, for which a slight premium was paid.

Silver Declines

The silver market has declined gradually during the last week as the result of withdrawal of buying orders for India and only moderate support coming from China. The undertone is quiet and uncertain.

According to recent statistical compilations of the A.B.M.S., silver production in the United States amounted to 5,361,000 oz. in May compared with 5,422,000 oz. in April and 5,223,000 oz. in March. Latest data available on world silver production indicates an output of 16,566,000 oz. in February, and 19,727,000 oz. in January, 1929, compared with a monthly average of 18,888,500 oz. for 1928. Recent curtailment of copper production is expected to have a similar effect on the silver output, as indicated in comparing domestic output for the months of April and May as shown above.

Mexican Dollars (old Mexican pesos): June 20th, 39⅞c.; 21st, 39¼c.; 22d and 24th, 39⅝c.; 25th, 39¾c.; 26th, 39⅝c.

Foreign Exchange

Closing cable quotations on the principal foreign exchanges on Tuesday, June 25, were: Francs, 3.91½c.; lire, 5.23½c.; and marks, 23.835c. Canadian dollars, 57/64 per cent discount.

Other Metals

Quotations cover large wholesale lots unless otherwise specified

ALUMINUM—Per lb., 99 per cent plus grades, price of leading interest, 24.30c. Outside market, 99 per cent plus, 24.30c.; 98-99 per cent, 23.90c.

ANTIMONY—Per lb., duty paid. New York: Chinese brands, 8¼c. per lb. for all positions. Cookson's "C" grade, spot, 14c.

BISMUTH—Per lb., New York, in ton lots, $1.70. Smaller lots, $1.85 and up.

CADMIUM — Per lb., New York: 80@95c. Active demand.

IRIDIUM — Per oz., $230@$240 for 98@99 per cent sponge and powder.

NICKEL—Per lb. ingot, 35c.; shot, 36c.; electrolytic, 35c. (99.9 per cent grade) for single lots of spot metal.

PALLADIUM — Per oz., $38@$40. Small lots bring up to $50. Nominal.

PLATINUM—Official price quoted by the leading interest on small miscellaneous orders for refined metal, $68 per oz. Transactions between dealers and refiners in the outside market are commonly reported at several dollars less.

QUICKSILVER — Per 76-lb. flask, $120@$121. Small lots command the usual premiums.

Prices of Chromium, Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tantalum, Tellurium, Thallium, Titanium, Tungsten, Vanadium, and Zirconium are unchanged from the issue of June 8.

Metallic Ores

TUNGSTEN ORE—Per unit of WO_3, N. Y.: Wolframite, $15.50@$16 for future delivery; Western scheelite, $15.50, for nearby, based on present tariff. Nominal.

Antimony, Chrome, Iron, Manganese, Tantalum, Titanium, Vanadium, and Zircon ores are unchanged from quotations in the June 8 issue.

Tri State Zinc and Lead Concentrate Prices Unchanged

Joplin, Mo., June 22, 1929

Blende	Per Ton
High	$46.75
Premium blende, basis 60 per cent zinc	$44.00@ 45.00
Prime Western, basis 60 per cent zinc	43.00@ 44.00
Table concentrates, 60 per cent zinc	41.00@ 43.00
Flotation concentrates, 60 per cent zinc	39.00@ 41.00
Average settling price, all zinc concentrates	44.27
Galena	
High	$93.20
Basis 80 per cent lead	90.00
Average settling price, all lead concentrates	91.16

Shipments for the week: Blende, 12,768 tons; lead, 2,287 tons. Value all concentrates the week, $773,810.

Prices for zinc and lead are reported unchanged by buyers. The lead shipment was increased 500 tons by one company that usually commands a premium price, but the buyer asserts that it was bought at the current market price. Shipment of zinc concentrates this week balanced closely with the last week's purchases, and the purchase this week will provide for a shipment of approximately 13,000 tons next week, providing it is all loaded.

Platteville, Wis., June 22, 1929

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$46.75
Lead Ore	
Lead, basis 80 per cent	$90.00

Shipments for the week: Blende, 722 tons; lead, 100 tons. Shipments for the year: Blende, 16,713 tons; lead, 860 tons. Shipments for the week to separating plants, 1,323 tons blende.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Silica, Spodumene, Sulphur, Talc, and Tripoli are unchanged from prices in the June 8 issue.

Metallic Compounds

ARSENIOUS OXIDE (White Arsenic) Per lb., 4c. Market more active.

Antimony Oxide, Calcium Molybdate, Copper Sulphate, Sodium Sulphate, Sodium Nitrate, and Zinc Oxide are unchanged from prices in the June 8 issue.

Alloys

FERROMANGANESE—Per long ton, domestic and foreign, f.o.b. furnace or duty paid, port of entry, $105. Spiegeleisen, 19@21 per cent, $33@$34 f.o.b. furnace.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent W, $1.25@$1.45 f.o.b. works. Market strong.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrophosphorus, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferrovanadium, Nickel Silver, and Yellow (Muntz) Metal are unchanged from prices in the June 8 issue.

Rolled Metals

Copper, Lead, Zinc, Monel Metal, and Nickel Sheets are unchanged from prices in the June 8 issue.

Refractories

Chrome Brick, Fireclay Brick, Magnesite Brick, Silica Brick and Zirkite are unchanged from quotations in the issue of June 8.

Iron, Steel and Coke

IRON—Per gross ton, Valley furnaces, Bessemer, $19; basic, $18.50; No. 2 foundry, $18.50.

STEEL—Base prices per gross ton Pittsburgh, billets and slabs, $35@$36; plates, structural shapes, and soft steel bars, per 100 lb., $1.95.

COKE—Per gross ton, Connellsville furnace, $2.75@$2.85. Connellsville foundry, $3.75@$4.85. Byproduct coke, Ohio and Kentucky (Connellsville basis) $6.50; Buffalo and Detroit, $8.50@$9.

Mining Stocks—Week Ended June 22, 1929

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	117⅛	109¼	117⅛	Mr.29,My.20	Q 1.75
Andes Copper	New York	55⅝	52	55⅝	Mr.29, My.6	Q 0.75
Arizona Com	Boston	3	3	3	Ja. 16, Ja. 31	S.A.0.25
Calumet & Aris	New York	133⅜	128⅛	130	My.31, Je.17	Q 2.50
Calumet & Hecla	Boston	44⅜	42⅛	43⅜	My.31, Je.29	Q 1.00
Cerro de Pasco	New York	102⅛	97⅛	100⅛	Ap.11, My. 1	Q 1.50
Chile Copper	New York	101	101	101	Je. 1, Je.28	Q 0.87½
Con. Coppermines	N. Y. Curb	13⅛	11⅞	12		
Copper Range	Boston	23½	22⅛	23⅛	Je. 15, Jl. 15	Q 0.50
East Butte	Boston	3½	3½	3½	Dec., 1919	0.50
Granby Con	New York	79⅛	76½	79⅛	Jl.12, Au.1	Q 1.75
Greene Cananea	New York	164½	150⅛	162⅛	Je. 6, Jl. 1	Q 2.00
Howe Sound	New York	69⅜	66½	67⅜	Je. 29, Jl. 15	Q 1.50
Hudson Bay	N. Y. Curb	17⅜	16½	16⅞		
Inspiration	New York	47⅜	44½	45⅛	Je.13, Jl. 1	Q 1.00
Isle Royale	Boston	23½	22	22	My. 31, Je.29	0.50
Kennecott	New York	87½	83⅜	86⅜	My. 31, Jl. 1	Q 1.25
Magma Copper	New York	70⅜	68	68⅛	Je.28, Jl.15	Q 1.25
Mason Valley	N. Y. Curb	1⅛	1⅛	1⅛		
Miami Copper	New York	43⅛	41⅛	43⅛	My1, My15	Q 1.00
Mohawk	Boston	56	54½	55⅜	Ap. 30, Je. 1	Q 1.50
Mother Lode	New York	3⅜	3⅛	3⅛	Je. 13, Je. 29	0.20
Nevada Con	New York	48⅜	46⅜	48	Je. 14, Je. 29	Q 0.75
Noranda	N. Y. Curb	54⅛	52⅜	54		
Ohio Copper	N. Y. Curb	2	1⅜	1⅜	Sept., 1926	0.03
Old Dominion	Boston	11	10½	10⅛	Dec., 1918	1.00
Phelps Dodge	New York	...	...	64	Je. 4, Jl. 1	Q 0.75
Quincy	Boston	39	37	38⅛	March, 1920	1.00
Roan Antelope	N. Y. Curb	49	46	46½		
St. Mary's M. L.	Boston	36½	35½	36	Fe.25, Mr.12	2.00
Seneca Copper	New York	5⅞	5½	5½		
Shattuck Denn	N. Y. Curb	18⅛	17⅞	18		
Sherritt-Gordon	Toronto	7.40	7.10	7.40		
Tenn. C. & C.	New York	18½	17½	18	My.31, Je.15	Q 0.25
United Verde Ex.	N. Y. Curb	19	18⅛	18⅜	Jl. 2, Au. 1	Q 1.00
Utah Copper	New York	300	294	300	Je. 14, Je. 29	Q 4.00
Waite-Ack.-Mont.	Toronto	6.25	4.75	5.20		
Walker Mining	Salt Lake	3.85	3.85	3.85		
Wenden Copper	N. Y. Curb	1⅜	1⅛	1⅛		
LEAD, ZINC, SILVER						
Ahumada Lead	New York	2½	2	2		
Amer. Z. L. & S.	New York	32⅜	29	30⅛	May, 1917	1.00
A. Z. L. & S., pfd.	New York	95	94½	95	Je.14, Jl. 1	1.50
Bingham Mines	Boston	56½	56½	56½	Mr.15, Ap.5	0.50
Bunker Hill & S.	N. Y. Curb	...	...	140	Ap.25, My.6	X 0.75
Butte Cop. & Zn.	New York	5⅛	4⅜	5		
Butte Cop. Con.	Boston Curb	*31	*30	*31		
Butte & Sup.	New York	7⅛	7	7⅛	Je. 14, Je. 29	Q 0.50
Callahan Zn-Ld.	New York	2	1⅞	1⅞	Dec., 1920	0.50
Chief Consol.	Salt Lake	3.25	3.05	3.10	Fe. 1, 1928	K 0.10
Consol. Ld. & Zn. "A"	St. Louis	14	14	14	Je.20, Jl.1	Q 0.25
Constitution	Spokane	*34	*32½	*32½		
Dayrock	Spokane	3.00	2.75	2.75	Je.20, Je.30	0.03
Dickens Consol.	Spokane	*5	*4½	*4½		
Eagle-Picher	Cincinnati	17	16⅛	16⅛	Je. 30, Jl.15	Q 0.20
Eagle-Pich., pfd.	Cincinnati	...	...	102	Je. 30, Jl. 15	Q 1.50
Erupcion	Boston Curb	...	...	*10	Ja. 1, 1928	Q 0.07½
Eureka Bullion	Salt Lake	*81	*76	*76		
Eureka Lilly	Salt Lake	...	...	1.42½		
Eureka Standard	Salt Lake	...	...	3.32½		
Evans-Wallower	N. Y. Curb	21½	19⅜	20⅛		
Evans-Wal., pfd.	N. Y. Curb	...	...	84½	Je.20, Jl. 1	Q 1.75
Federal M. & S.	New York	250	250	250	Je., 1927	10.00
Fed. M. & S., pfd.	New York	100	100	100	My.24, Je.15	Q 1.75
Gladstone	Spokane	*10⅛	*9⅛	*9⅛		
Golconda	Spokane	1.27	1.18	1.18	Je.15, Jl.1	0.02
Grandview	Spokane	*41	*37	*39½		
Hecla Mining	N. Y. Curb	18	17½	17⅝	My.15, Je.15	Q 0.25
Highland-Surprise	Spokane	*13½	*13	*13		
Jack Waite	Spokane	* 9	*8⅛	*8⅛		
Kootenay Florence	Spokane	*16	*14½	*14½		
Lucky Jim	Spokane	*12½	*10	*12		
Lucky Tiger-C.	Kansas City	†4.25	†3.50	....	Je.10, Je. 20	M 0.05
Mexican Premier	Spokane	2.37	2.28	2.28		
National Lead	New York	153	146	152	Je. 14, Je. 29	Q 1.25
Natl. Lead, pfd. A	New York	141	138⅛	141	Mr. 1, Mr. 15	Q 1.75
Natl. Lead, pfd. B	New York	...	...	120	Jy. 19, Au 1	Q 1.50
N. J. Zinc, new	N. Y. Curb	80⅜	77⅓	78⅛	Jl.20, An.10	Q 0.50
New Quincy	Salt Lake	2.52½	2.20	2.30	My.15, My.27	Q 0.10
Noble Five	Spokane	*57	*52	*57		
North Lily	Salt Lake	7.10	6.00	7.00	Jan. 20	Q 0.25
Park Bingham	Salt Lake	8.50	8.00	8.00		
Park Utah	New York	8⅛	8	8	Je. 14, Jl. 10	Q 0.20
Pend Oreille	Spokane	4.50	4.00	4.50		
Rico Argentine	Salt Lake	*37	*34	*37	No. 30, De. 15	Q 0.03
Ruth-Hope	Spokane	*40	*32	*39		
St. Joseph Lead	New York	71½	67½	68⅜	Se.10,Se.20	QX 0.75
Sherman Lead	Spokane	*39	*37	*39		
Silver King Coa.	Salt Lake	12.87½	12.50	12.50	Je. 20, Jl. 25	Q 0.25
Silversmith	Spokane	*12⅛	*12	*12	Oct., 1926	Q 0.02
Sunshine Mining	Spokane	3.00	2.98	2.98	Je. 10, Je. 20	BM 0.05
Tamarack-Custer	Spokane	*75	*63	*66	Sept., 1924	0.25
Tintic Standard	Salt Lake	12.75	12.75	12.75	Je. 17, Je. 29	QX 0.30
Tonopah Belmont	N. Y. Curb	....	....	*56⅛	Oct., 1925	0.05
Treadwell-Yukon	Toronto	....	....	10.00		
United Zinc Smg.	N. Y. Curb	*68⅛	*62½	*62½		
Utah Apex	Boston	3⅜	3⅜	3⅜	May 15, June 1	0.25
Utah Met. & Tun.	Boston	1	*90	1	Dec., 1917	0.30
Whitewater	Spokane	*90	*70	*88		
Yellow Pine	Los Angeles	....	....	*8	Dec., 1925	QX 0.04
GOLD						
Alaska Juneau	New York	6⅛	5⅝	5⅞		
Barry-Hollinger	Toronto	*29	*26	*28		
Central Manitoba	Toronto	*48	*45	*45		
Coniaurum	Toronto			*40		
Cresson Consol.	N. Y. Curb	*75	*68½	*75	Mr.30, Ap.10	Q 0.02
Dome Mines	New York	10⅛	9⅛	10	Jl. 20,	Q 0.25
Golden Cycle	Col. Springs	†1.95	†1.90	....	Fe.15, Mr. 1	0.04
Gold Hill	Toronto	*3	*2	*2⅛		
Hollinger	Toronto	5.75	5.60	5.60	Je.28, Jl. 15	M 0.05
Homestake	New York	73	72½	72½	My.20, My.25	M 0.50
Kirkland Lake	Toronto.	*92	*85	*85		
Lake Shore	Toronto	25.50	24.25	25.25	Je.1, Je.15	Q 0.20
McIntyre-Porc.	New York	16⅛	16⅛	16⅛	My.1, Je.1	Q 0.25
Portland	Colo.Springs	†*11	†*10	....	April, 1927	0.02
Rand Mines	New York	....	....	35	Fe. 21,'28	Am.Sh.1.52
Siscoe	Toronto	*67	*61	*64½		
Sylvanite	Toronto	1.25	1.10	1.16		
Teck-Hughes	Toronto	8.70	8.40	8.50	Ap. 7,My 1,	O 0.15
Tom Reed	Los Angeles	*48½	*40	*40	Dec., 1926	0.02
Unity Gold	N. Y. Curb	1⅛	1	1⅛		
Vipond Consol.	Toronto	*91	*84	*86½	April, 1927	0.03
Wright-Hargreaves	Toronto	1.80	1.35	1.73	Oc. 16, No. 1	0.02½
Yukon-Alaska	N. Y. Curb	....	....	35⅛		
GOLD AND SILVER						
Carnegie Metals	N. Y. Curb	16⅞	16½	16⅜		
Castle-Trethewey	Toronto	*35	*32	*32		
Consol. Cortes	N. Y. Curb			*12½		
Dolores Esperanza	N. Y. Curb	*93½	*93½	*93½	July, 1923	0.05
Keeley	Toronto	*47	*46	*46	Mr.15, 1928	0.04
Mining Corp.	Toronto	4.20	4.00	4.20	My 30, Je.13	0.12½
Montana-Idaho	Spokane	*12⅜	*11	*11		
N. Y. & Hond. Ros.	N. Y. Curb	....	....	17⅛	Ap.17,Ap.27	QX 0.05
Nipissing	N. Y. Curb	2⅜	2⅛	2⅛	Je.29, Jl.20	Q 0.07½
Premier Gold	N. Y. Curb	1⅜	1⅛	1⅛	Je.13, Jl.3	Q 0.06
Tonopah Exten	N. Y. Curb	....	....	*10	April, 1925	0.05
Tonopah Mining	N. Y. Curb	3⅛	3⅛	3⅛	Ap. 7, Ap. 20	0.07½
United Eastern	N. Y. Curb	*31½	*25	*25		
Yukon Gold	N. Y. Curb	....	....	*68⅛	June, 1918	0.02
IRON AND STEEL						
Bethlehem Steel	New York	108⅛	104⅛	107⅛	Jl.19, Au.15	Q 1.00
Beth. Steel, pfd. 7%	New York	118⅛	117⅛	118	Je.1, Jl.1	Q 1.75
Cleveland-Cliffs	Cleveland	140	90	130	Je. 6, Je. 15	5.00
Colo. Fuel & Iron	New York	64	59⅛	64		
Colo. F. & I., 1st pfd.	New York	...	...	78	My.10,My.25,	Q 2.00
Great Northern Iron.	New York	29⅛	28⅛	28⅛	Dec.15,	K 2.00
Inland Steel	New York	91⅛	89	90	My.15, Jn. 1,	Q 0.87½
Republic I. & S.	New York	96⅛	92⅛	95⅛	My. 11, Je. 1,	Q 1.00
Republic I. & S., pfd.	New York	....	....	111	Je .12, Jl. 1,	Q 1.75
Sloss-Sheffield S. & I.	New York	61	61	61	Mr. 11, Mr.20,	Q 1.50
Sloss-Sheff. S. & I., pfd.	New York	85	85	85	Je.20, Jl.1,	Q 1.75
U. S. Steel	New York	181⅛	174⅛	180⅛		
U. S. Steel, pfd.	New York	54	53	54	My. 4,My 29,	Q 1.75
Virginia I. C. & C.	New York	....	....	25⅛	Jan., 1924	1.50
Virginia I.C.& C., pfd.	New York	....	....	45	Jl.16, 1928	SA 2.50
MISCELLANEOUS						
Aluminum Co. of Am.	N. Y. Curb	290	276⅛	290		
Alum.Co.of Amer., pf.	N. Y. Curb	106½	106½	106½	Mr.15, Ap.1,	Q 1.50
American Metal	New York	59⅛	57⅛	59⅛	My.9, Je. 1	Q 0.75
Amer. Metal, pfd., 6%	New York	...	...	115½	My.21, Je.1,	Q 1.50
Amer. Sm. & Ref.	New York	106⅛	102	106⅛	Je. 30, Jl. 12	Q 1.00
Amer. & Sm. Ref., pfd.	New York	133½	133	133	Au. 3, Se. 1	Q 1.75
Ang. Ch. Nitrate	N. Y. Curb	42⅛	39	41		
Asbestos Corp.	Montreal	11	10	11	Jan. 1926	1.50
Asbestos Corp., pfd.	Montreal	35	35	35	De. 31, Ja. 15	Q 1.75
Consol. M. & S.	Montreal	400	399	400	Je.29,Jl.15,	SAX 6.25
De Beers Consol.	New York	....	....	23	Ja. 19, Ja.26,	0.48
Federated Metals	N. Y. Curb	35	31	34⅛	Je.25, Jl.5	Q 0.75
Freeport Texas	New York	48⅛	45½	46	Jl. 5, Au.1	Q 1.00
Int. Nickel Can.	New York	50⅛	48½	49⅞	Je.1, Je.29	Q 0.20
Int. Nickel, pfd.	New York	....	....	120	Jl.1, Au.1	Q 1.75
Mayflower Assoc.	N. Y. Curb	72	70⅛	72		
Metal & Mining	N. Y. Curb	22⅛	19⅛	22⅛	Je.20, Jl.1	Q 0.30
Newmont	N. Y. Curb	203	195	198½	Je.29, Jl.15	Q 1.00
Patiño M. & E.	New York	38⅛	36⅛	38	My. 31, Jn. 28	4a
So. America G. & P.	N. Y. Curb	....	....	2⅛		
Texas Gulf Sulphur	New York	74⅛	72	73⅛	Je.1, Je.15	Q 1.00
U. S. Sm. R. & M.	New York	59	55	59	Ap. 4, Ap. 15	Q 0.87½
U. S. Sm. R. & M., pfd.	New York	54	53	54	Ap. 4, Ap. 15	Q 0.87½
Vanadium Corp.	New York	84⅛	80	83⅛	Fe.1, Fe. 15	Q 0.75

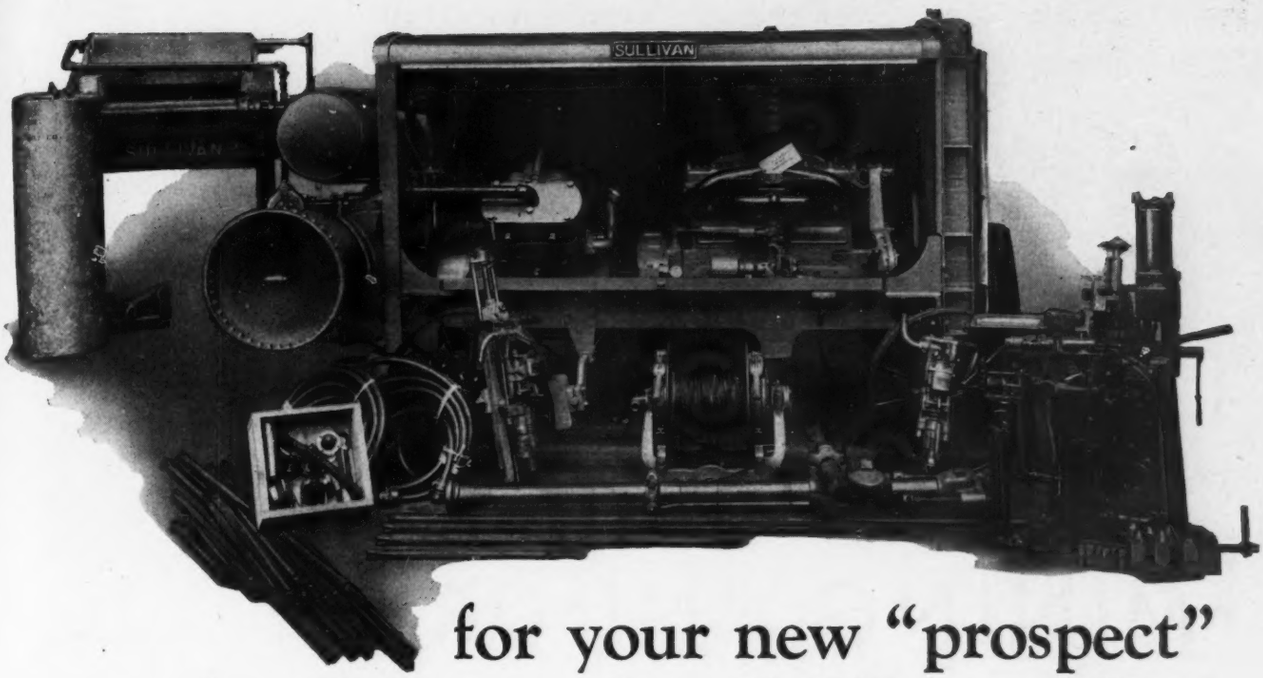
Toronto Standard Stock Exchange, Toronto, courtesy Arthur E. Moysey & Co.; Salt Lake Stock Exchange, courtesy J. A. Hogle & Co. and Logan & Bryan, New York; Standard Stock Exchange, Spokane, courtesy Pohlman Investment Company.

*Cents per share. †Bid or asked. Q, Quarterly. A. Annually. SA, Semi-annually. M, Monthly. BM, Bimonthly. FW, Four weeks. K, Irregular. I, Initial. R, Resumption. X, Extra. The first date given is that of the closing of the books: the second that of the payment of the dividend.

LONDON QUOTATIONS—WEEK ENDED June 1, 1929

	High	Low	Last	Date	Amount
Alaska Mexican ($5)	20/—	20/—	20/—		
Alaska Treadwell (25)	60/—	60/—	60/—	Nov., 1926	4 p.c.(d)
Aramayo Mines (25 frs.)	60/—	58/1½	60/—	May 1929	5 p.c.(†)
Burma Corp (10 rupees)	19/—	18/3	19/—	Feb., 1929	7 annas*
Bwana M'Kubwa (5s)	20/9	19/1½	20/3		
Camp Bird (2s)	2/6	2/3	2/4½	April, 1928	16⅔ p.c.
El Oro (£1)	4/10½	4/6	4/10½	Nov., 1924	2½ p.c.*
Frontino & Bolivia (£)	8/7½	8/7½	8/7½	Jan., 1929	3¾ p.c.
Mexican Corpn. (£1)	15/7½	13/6	15/6		
Mexico Mines of El Oro (£1)	8/9	6/6	7/6	Dec., 1926	3¾ p.c.*
Mount Isa (£)	45/6	40/9	44/4½		
N'Changa Copper Mining. (£1)	94/4½	72/6	88/9		
Oroville Dredging (4s)	1/9	1/7½	1/9	Nov., 1928	31½ p.c.
Rhodesian Congo Border (£1)	213/9	157/6	202/6		
St. John del Rey (£1)	17/10½	17/3	17/9	Apr., 1929	7½ p.c.
San Francisco Mines (10s)	37/	36/6	36/10½	Jan., 1929	25 p.c.
Santa Gertrudis (£1)	10/6	10/1½	10/3	Jan, 1929	7½ p.c.
Selukwe (2s. 6d.)	5/10½	5/6	5/9	April, 1917	6⅔ p.c.
S. Amer. Copper (2s.)	2/9	2/1½	2/6	Nov. 1917	75 p.c.
Tanganyika (£1)	63/9	58/1½	61/3	July, 1928	5 p.c.
Union Miniere du Haut-Katanga (Brussels)	11,450	11,210	11,260	April, 1929	300.00 fr.

*Free of British income tax. †Swiss francs and plus 15 p. c. bonus. ‡Belgian francsand free of taxation. (d) U. S. Dollars.



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When you are ready to develop your new mineral prospect you will need a rock drilling outfit sufficient to sink a shaft and open up a level or two, or drive an adit. You will, perhaps, be away from supply bases or shops for a whole season.

The outfit illustrated has been furnished to many companies for their early development work, and has proven popular and satisfactory.

It includes an air compressor, Rock Drills, Drill Mountings, hose and steel, a drill steel sharpener and oil furnace, and a portable Air Hoist.

This outfit is easily transported by any route or means at hand. The compressor and sharpener may be dismantled for canoe, mule-back or airplane carriage if desired. All items are standard Sullivan Equipment, known for their staunchness and dependability, as well as for their efficiency. Each item plays an important necessary part. The group as a whole will handle development under any conditions until you are ready to install permanent equipment.

The outfit may be varied as to size of compressor, size or type of drills, to suit expected conditions. Inclusion of the sharpener and furnace are strongly urged for their stimulating effect on drilling work.

The hoist will prove invaluable for handling timbers, hauling machinery, pulling cars, sinking shafts, erecting structures, etc.

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6—Sets 1-in. hollow hex. drill steel, to 8 ft.
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1—All-Hammer light drill Sharpener, with dies and dollies, for both bits and shanks, and with steel punch.
1—Oil Steel Heating Furnace with pressure tank.
1—HA-2 Turbinair Hoist, with 1,500 ft. ⅝-in. wire rope.
1—Lot selected spares, for ordinary replacements.

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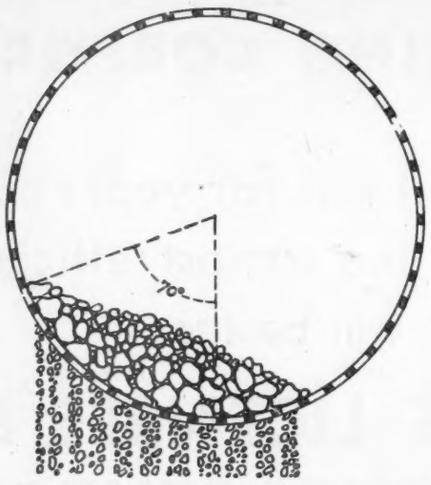
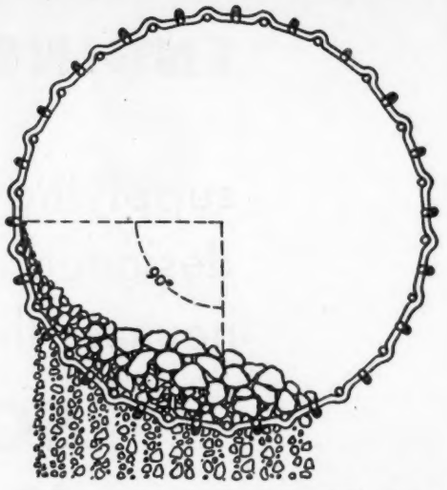
ROOM 1217 MAGNOLIA BLDG., DALLAS, TEXAS

TRANSPORTATION BLDG.
MONTREAL, CANADA

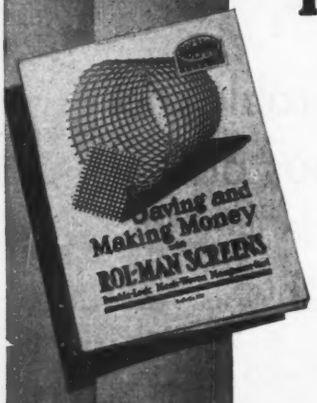


This diagram illustrates the action of material passing through a revolving screen equipped with perforated plate. Note that the material is carried to a height of only about 70 degrees up the side. The cascade is thick or bulky, and the action is such that a large part of the material is carried up in a mass and then slides back, so that undersize material does not have free opportunity to get down to and through the screen openings. As a result, the capacity is limited, and there is a considerable carry-over of undersize material.



Material passing through a ROL-MAN-equipped revolving screen is carried up the side to a height of 80 to 90 degrees. This means that the material is spread out more thinly and the undersize is exposed to much more of the available open space than with perforated plate. Likewise, there is more of a tumbling action than a sliding action, the material being constantly turned over, which serves to work the undersize down to and through the mesh openings. There is a minimum of carry-over; in many cases none at all.

Increased Capacity on Revolving Equipment *with* ROL-MAN Screens



Much more rapid and thorough screening action, together with a greater amount of open space and fewer blind spots, makes it possible to handle maximum tonnage on trommels equipped with ROL-MAN Manganese-Steel Screens. In addition, the Double-Lock Mesh Weave insures accurate grading throughout the entire life of a ROL-MAN Screen.

Detailed facts on the application of these modern screens to revolving, vibrating, shaking and inclined-gravity equipment are given in Bulletin 120. Write for a copy.

Reduce maintenance on chutes, buckets, spouts, hoppers, bins and car bottoms and liners by using ROL-MAN Rolled Manganese-Steel Liner Plates. Write for prices on sizes and shapes to meet your specifications.

ROL-MAN
DOUBLE LOCK MESH WOVEN MANGANESE STEEL
SCREENS

MANGANESE STEEL FORGE COMPANY

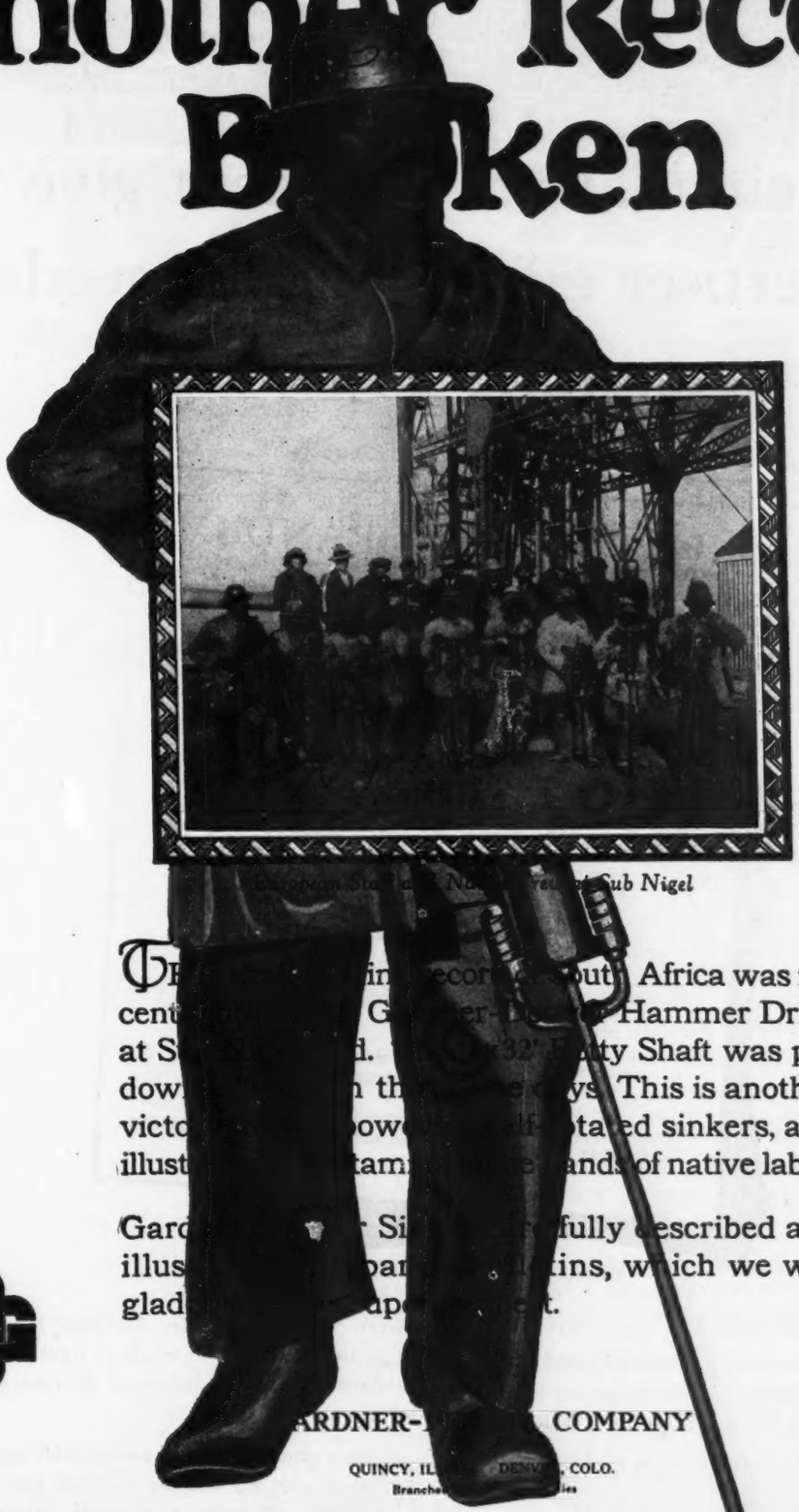
Manufacturers of

ROL-MAN ROLLED *and* FORGED MANGANESE STEEL PRODUCTS

Richmond Street and Erie Avenue, Philadelphia, Pa.

NEW YORK	PITTSBURGH	DETROIT	CLEVELAND	CHICAGO	LOS ANGELES
30 Church St.	Clark Bldg.	Lexington Bldg.	Union Trust Bldg.	Builders Bldg.	320 S. San Pedro St.

Another Record Broken



European Staff at New Vault Sub Nigel

The [illegible] in record [illegible] South Africa was recently [illegible] Gardner-Denver Hammer Drills at [illegible]. [illegible]-32' Vertical Shaft was put down [illegible] in three days. This is another victory [illegible] power [illegible] rotated sinkers, and illustrates [illegible] tamiliar [illegible] hands of native labor.

Gardner-Denver Sinkers are fully described and illustrated [illegible] bar [illegible] tins, which we will gladly [illegible] upon request.

GARDNER-[illegible] COMPANY

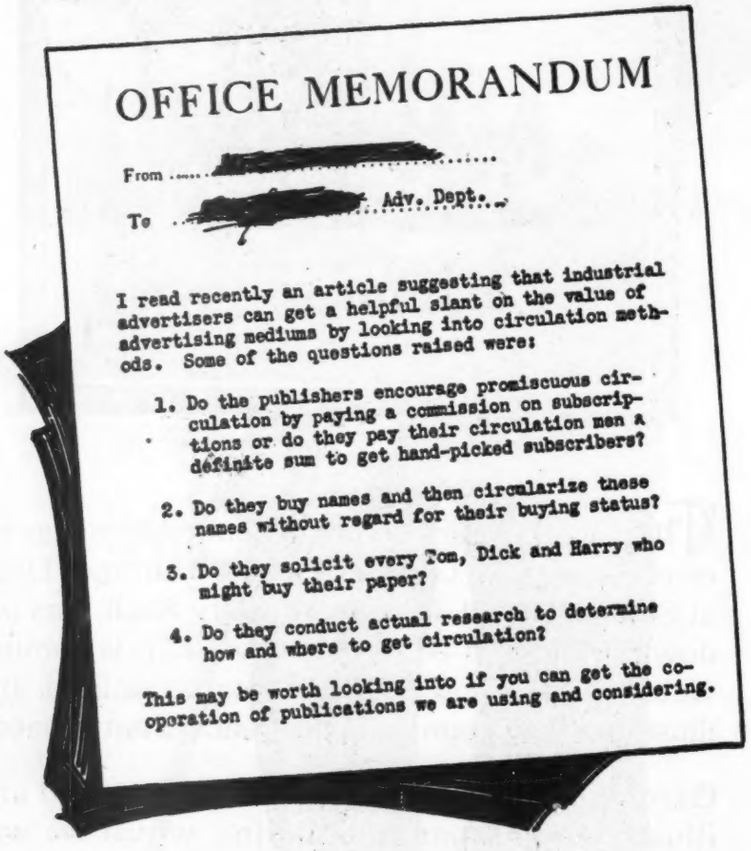
QUINCY, ILL. [illegible] DENVER, COLO.

Branches [illegible] Cities

GARDNER-DENVER

This is one of a series of McGraw-Hill advertisements directed originally to advertising men in an effort to make industrial advertising more profitable to buyer and seller. It is printed in these pages as an indication to readers that McGraw-Hill publishing standards mean advertising effectiveness as well as editorial virility.

Can a circulation statement give the advertiser everything he needs concerning a medium?



OFFICE MEMORANDUM

From .....

To ..... Adv. Dept.

I read recently an article suggesting that industrial advertisers can get a helpful slant on the value of advertising mediums by looking into circulation methods. Some of the questions raised were:

1. Do the publishers encourage promiscuous circulation by paying a commission on subscriptions or do they pay their circulation men a definite sum to get hand-picked subscribers?
2. Do they buy names and then circularize these names without regard for their buying status?
3. Do they solicit every Tom, Dick and Harry who might buy their paper?
4. Do they conduct actual research to determine how and where to get circulation?

This may be worth looking into if you can get the cooperation of publications we are using and considering.

AT McGraw-Hill circulation headquarters in New York there is a large map. On it here and there are colored pegs which show what circulation we do not have—plants, utilities or service organizations whose buying power should be covered by a McGraw-Hill publication.

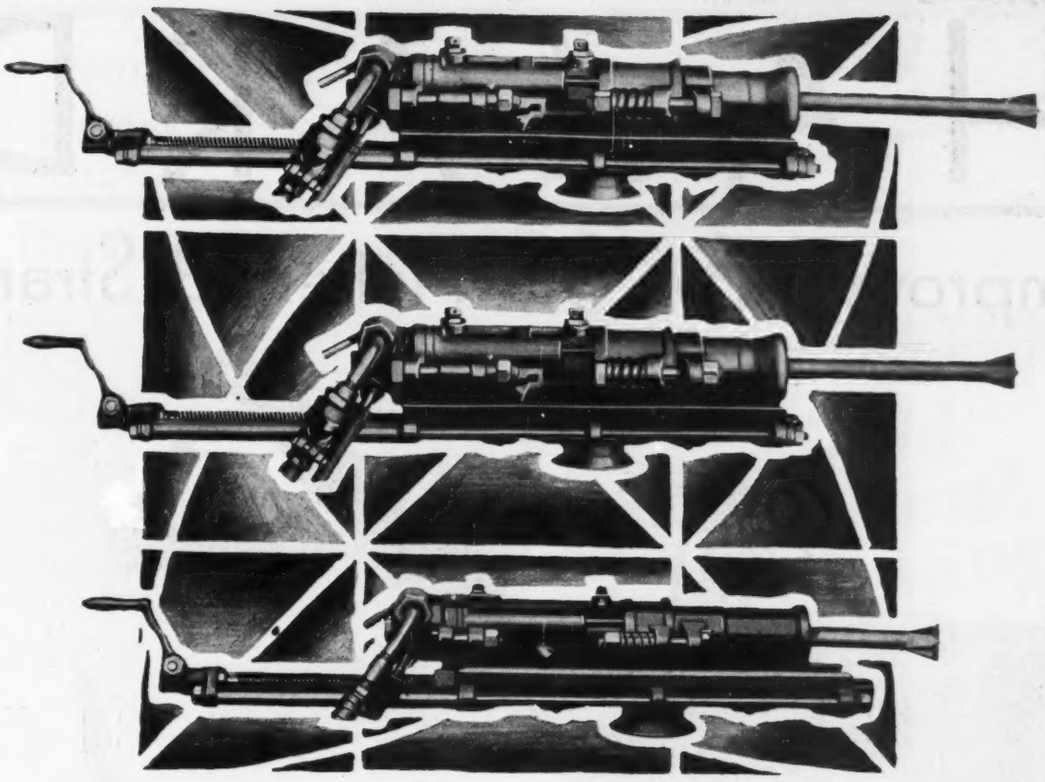
No one—publisher or manufacturer—can map his prospects in this way without continuous research.

Between 50 and 60 salaried McGraw-Hill circulation men participate in this research to locate, rate and get only those men whom industrial advertisers are after for business.

Advertisers and advertising agents who are interested in industrial markets and the electrical and radio trade are welcome to make a personal investigation of McGraw-Hill circulation methods. Group visits to headquarters are being made all the time.

—The publishers

F-9



For Your Convenience - - -

A Complete Line

Two years ago we introduced the Cleveland D8 Drifter. New in design and construction its unusually low air consumption, low repair cost and remarkable drilling records commanded instant popularity. It rapidly became known as the one-man drifter with the punch of a two-man machine.

Now we offer, for what we believe to be the first time, a complete line of one-man drifters.

The D7, weighing but 115 pounds, is designed for soft and medium ground, but its performance in even the hardest rock, due to exceptional power and hole cleaning ability, makes it a formidable rival of heavier drifters.

The D9 will stand the toughest service to which a one-man drifter can be subjected. Like the D8 it operates on jobs that, formerly, could be done only with heavy two-man drifters.

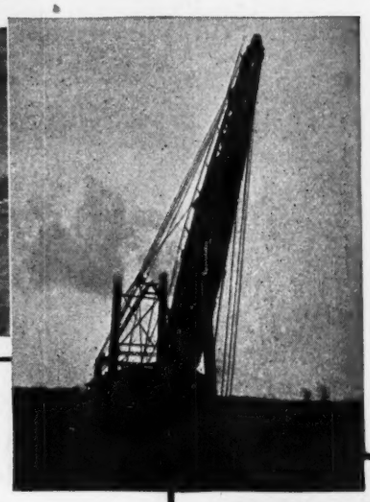
We'll match our time against yours. Let us demonstrate all three drifters on any work you select. The machines can speak for themselves, and you alone will judge the correctness of our claims. Write—

THE CLEVELAND ROCK DRILL COMPANY
3734 E. 78th St., Cleveland, Ohio
Branches, Agents and Service Stations in principal Cities and Mining Centers of the World.

CLEVELAND ROCK DRILLS

HAZARD

Improved 6 x 30 Flattened Strand



for Stripping Operations

HAZARD IMPROVED 6 x 30 Wire Rope combines all the qualities essential for economical stripping shovel service.

Made up of all round wires, all chafing or nicking of strands which cause early fatigue and breaking of wires is eliminated.

The large outer wires give it a wearing surface even greater than the usual 6 x 19 ropes. And the special patented construction gives it a flexibility equal to the usual 6 x 37 ropes.

In Hazard Improved 6 x 30 you have a combination of strength, wearing surface and flexibility unequalled for heavy stripping operations. Try it for your next rope.

Complete stocks carried at branches listed and by distributors

Hazard Wire Rope for Every Service

Room Hoists	Mining Machines	Haulage Ropes
Power Shovels	Drag Lines	Slope Ropes
Shaft Ropes	Aerial Tramways	Special Ropes

HAZARD WIRE ROPE COMPANY

WILKES-BARRE PENNSYLVANIA

San Francisco Pittsburgh Chicago Tacoma Birmingham New York Denver Los Angeles

Compressed Air Quickly Finds the Weakness in Ordinary Packings

Avoid Frequent Repacking

by using a packing that will withstand the high temperatures of

COMPRESSED AIR
and
High Pressure STEAM
Superheat

Such a packing should be made entirely of heat resisting materials, and so perfectly lubricated that it will not harden and create friction.

TRADE MARK

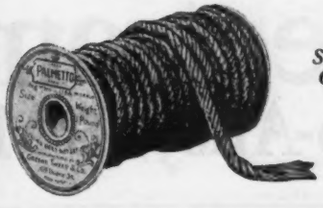
"PALMETTO" PACKING

REG. U.S. PAT. OFFICE

is made especially to resist the extreme temperatures that destroy ordinary packings, having a grade of long fibre high tensile strength asbestos that does not require the addition of cotton, and is the recognized packing to use under Compressed Air and Superheated Steam, where the long service of true economy is desired.

GREENE, TWEED & CO.
Sole Manufacturers
109 Duane St., New York

Let us send you a free working sample to test under your own conditions. State size desired.



See Keystone Metal Quarry Catalog for Details.

High-Pressure Power...

OPERATING economy . . . lower maintenance . . . increased capacity . . . greater output from prime movers per unit of floor space . . . These advantages demonstrated in the practical operation of twelve-hundred-pound steam-electric stations are urging power engineers to design for still higher pressures.

This modern trend emphasizes the growing importance of high strength Alloy Steel for power plant equipment and piping. Higher steam pressures and increased temperatures demand added tensile strength and increased elastic limit—qualities available in Alloy Steels.

Electromet engineers will gladly demonstrate the proper use and benefits to be derived from the use of Electromet Brand Ferro Alloys.

ELECTRO METALLURGICAL SALES CORP.
Unit of Union Carbide and Carbon Corporation
Carbide and Carbon Building, 30 East 42nd Street
New York, N. Y.

Electromet
Ferro-Alloys & Metals

2½ square miles contoured in 2 days by two men using *Paulin System* ALTIMETERS

The Paulin System Altimeter for practical field use is sensitive to the slightest changes in elevation, being readable to differences of two feet. Each instrument comes securely encased in a heavy leather carrying case equipped with hand and shoulder straps. Weight approximately 23 ounces. Specify whether dial and instrument should be graduated to meters or feet.

THE above aerial photograph, made at 12,000 feet altitude by The Texas Company aerial surveyors, using the Paulin System Level Flight Indicator, shows approximately 2½ square miles of land under survey. With the print as a basis, two men with Paulin System Altimeters contoured this tract in two days. The contours are at 50 foot intervals. You too can cut down the time and labor cost on your preliminary surveys by using this highly sensitive and extremely accurate instrument. Mail the coupon below for a free copy of the "Paulin System Altimetry Manual." It will interest all engineers. Address the coupon to our nearest office.

The AMERICAN PAULIN SYSTEM, Inc.

General Offices and Manufacturing Laboratories

1220 MAPLE AVE., LOS ANGELES, CAL.

Eastern Office

55 WEST 42ND ST., NEW YORK CITY

Dealers in principal cities of North and South America, Japan, China and all U. S. Possessions

MJ-6

The American Paulin System, Inc.,
1220 Maple Ave. Los Angeles, Cal.
55 West 42nd St. New York City

Please send me by return mail a free copy of the "Paulin System Altimetry Manual for Engineers."

Name.....

Address.....

Instrument Dealer.....

DO IT BY OXWELDING

AS pioneers in every phase of oxy-acetylene welding and cutting, the thoroughly experienced engineering and service organizations of these companies can help you in the proper application of oxwelding to your present work and to new production activities.

Fulfilling every need for Oxwelding and Cutting.....

LINDE OXYGEN
The Linde Air Products Company

Prest-O-Lite
Dissolved Acetylene
The Prest-O-Lite Company, Inc.

Oxweld
Apparatus and Supplies
Oxweld Acetylene Company

UNION CARBIDE
Union Carbide Sales Company

Units of
UNION CARBIDE AND CARBON CORPORATION

General offices
30 East 42nd Street
New York, N. Y.

UCC

Sales offices in
Principal cities
throughout the country

64 Linde plants—45 Prest-O-Lite plants—154 Oxygen Warehouse stocks—138 Acetylene Warehouse stocks—38 Apparatus Warehouse stocks—235 Carbide Warehouse stocks

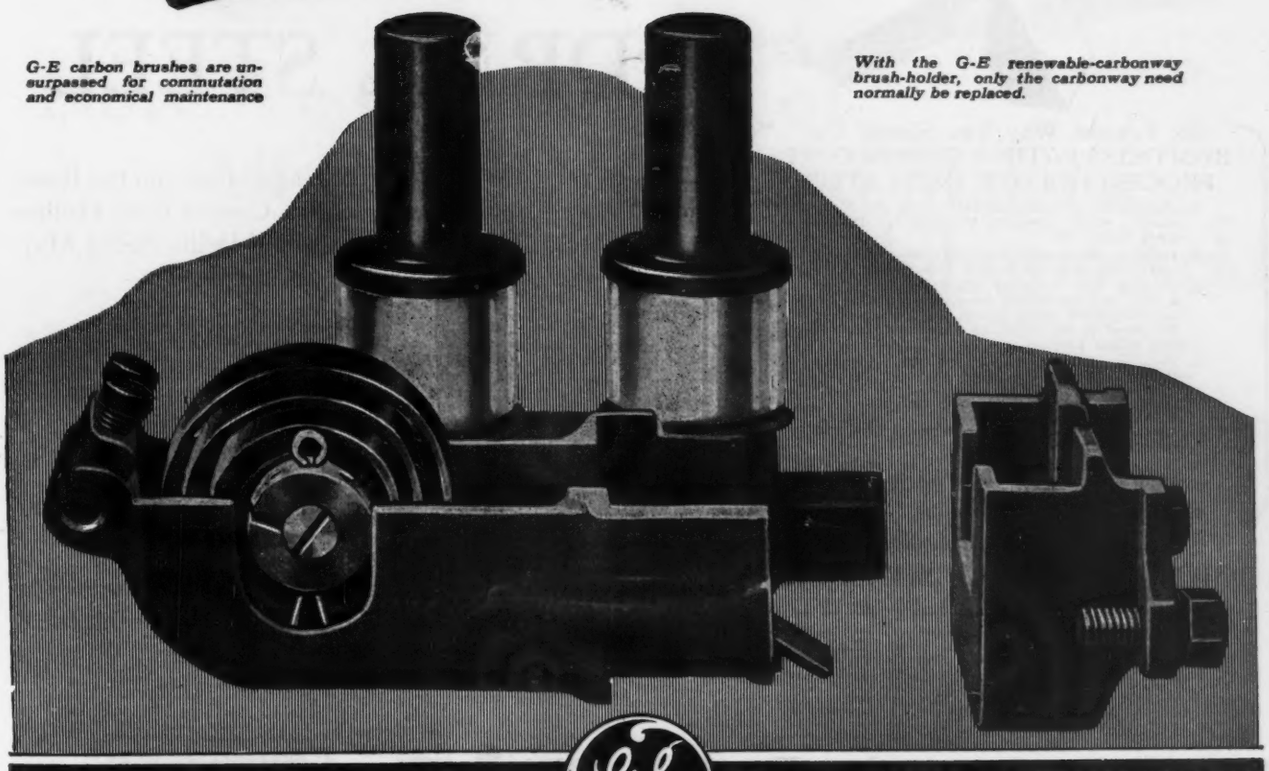
Invest in good commutation

When you buy G-E brushes and brush-holders, you do more than purchase replacement parts. You make a sound investment in good commutation.

Good commutation means low maintenance costs.

G-E carbon brushes are unsurpassed for commutation and economical maintenance

With the G-E renewable-carbonway brush-holder, only the carbonway need normally be replaced.



360-35

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y., SALES OFFICES IN PRINCIPAL CITIES

A NEW SHAFT SINKING RECORD *with* COPPER CORE HOLLOW DRILL STEEL

AT No. 4 Vertical Shaft Springs Mines, on the Rand, using Bedford's ⅞ in. dia. Copper Core Hollow Drill Steel in N70 Leyner-Ingersoll Drills during May, 1928, the following results were obtained:—

Size of Shaft	31 ft. x 13 ft.
Depth Sunk for Month	300 ft.
Working Days	31
Footage Advanced	9.68 ft. per day
Number of Machines	7

Which constitutes a record for Sinking a Rectangular Shaft on the Rand.

This is the same Drill Steel that outlasted all others in a test of 7 foremost makes, on 40 shifts under identical conditions. It will cut costs in your mines. Write us for details.

Six Reasons Why You Should Use BEDFORD'S PATENT COPPER CORE PROCESS HOLLOW DRILL STEEL

1. Because it is manufactured from the finest quality steel, especially suitable for drilling hard rock.
2. Because every drill steel rod is guaranteed physically and chemically uniform.
3. Because the "Copper Core" is the only known process which permits of the physical guarantee being given. Impossible for the steel to be burnt or overheated during the rolling process.
4. Because the hole is central, parallel throughout the length of the rod; is perfectly smooth and without defects. Rough and pitted walls of the hole of other drill steels cause early deterioration and form the starting point of breakage due to fatigue from vibration.
5. Because the grain structure is fine and uniform throughout the whole diameter of the rod.
6. Because the price is competitive.

Sole Makers and Patentees

JOHN BEDFORD & SONS, Ltd.

Lion Works—SHEFFIELD, ENGLAND

SALES AGENTS: *Canada:* D. R. Macdiarmid, P. O. Box 534, New Liskeard, Northern Ontario. E. G. Cullen, 543 Granville Street, Vancouver, British Columbia. *Newfoundland:* William Heap & Co., Ltd., Board of Trade Building, Water Street, St. John's. *Australia:* H. James Daggar Pty. Ltd., McEwan House, 343-9 Little Collins Street, Melbourne. *South Africa:* H. Alers Hankey Limited, The Bank House, Main Street, Johannesburg. *England:* John Bedford & Sons, Ltd., 271 Finsbury Pavement House, 120 Moorgate, London, E.C. 2.

BEDFORD'S *Patent Copper Core Process* HOLLOW DRILL STEEL

Now We Can Get Rid of All Our SO_2 Gas and Make a Real Profit on Sulphuric Acid!

Investigate this astounding new process which ushers in a new era in Sulphuric Acid production. Write for descriptive booklet illustrating a recent installation by Chemical Construction Co., who have already placed in operation and have under construction plants having an annual capacity of 400,000 tons of H_2SO_4 equivalent.

Here are the facts! The Selden Company have perfected a *contact* sulphuric acid process which will solve our SO_2 gas problem. We can make, sell and ship the H_2SO_4 so cheaply that we cannot only compete with *chamber* process acid but actually show a real profit!

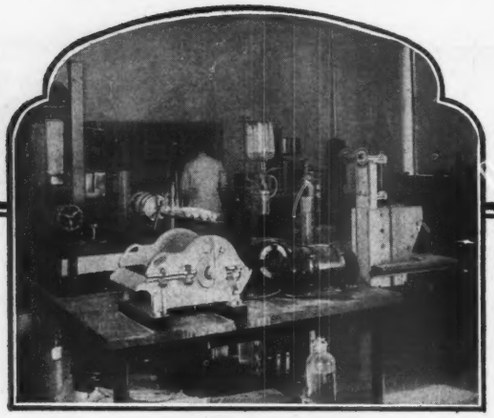
This, in a nutshell, is the story the president of practically every smelting company and mining company operating a smelter will hear from his executives within the next few months—and he will be hearing facts! Sulphuric Acid production methods have been revolutionized, almost overnight, by the most important contribution to the art in a quarter century.

For the first time, contact sulphuric acid production has been placed upon an automatically controlled basis making it possible to operate an entire plant from a single control point. Heretofore existing limitations of converter size and capacity have been eliminated by the radically different design and construction of The Selden Company's New Compound Heat Exchange Converter System and New Non-Platinum Catalyst [stabilized for long life].

Existing contact plants can be easily changed over with practically no cash outlay as the salvage on the platinum contact mass will finance the change-over. So sensational are the benefits of this new process that the discarding of a chamber plant in favor of a new contact plant would pay-out in a comparatively short time.

THE SELDEN COMPANY

A-595 Selden Chemical Square
Pittsburgh, Penn., U.S.A.



FLOTATION—having become distinctively a chemical art—now employs chemical reagents with a degree of efficiency in concentration heretofore unapproached.

In this field the American Cyanamid Company has played an active part. The facilities of its fully equipped modern laboratories have been devoted to the study of chemical reagents and their effect upon the flotation of ores.

Through these researches and close contact with the mining industry throughout the world, new and valuable reagents have been developed and a complete line of metallurgical chemicals made available at strategic distribution points.

AMERICAN CYANAMID COMPANY — AERO BRAND — PRODUCTS

This list includes:

Aero Brand Cyanide	*Sodium Carbonate*
Aerofloat, Floatation Reagent	*Sodium Cyanide*
Amyl Xanthate	*Sodium Silicate*
Butyl Xanthate	*Sodium Sulphide*
Copper Sulphate	*Sodium Sulphite*
Cresylic Acid	*Thiocarbanilide*
Lead Acetate	*Xanthate, Potassium*
Orthotoluidine	*Xanthate, Sodium*
Pine Oil	*Zinc Dust*
Soda, Caustic	*Zinc Sheets*
Sodium Bicarbonate	*Zinc Sulphate*

For quotations and full information write

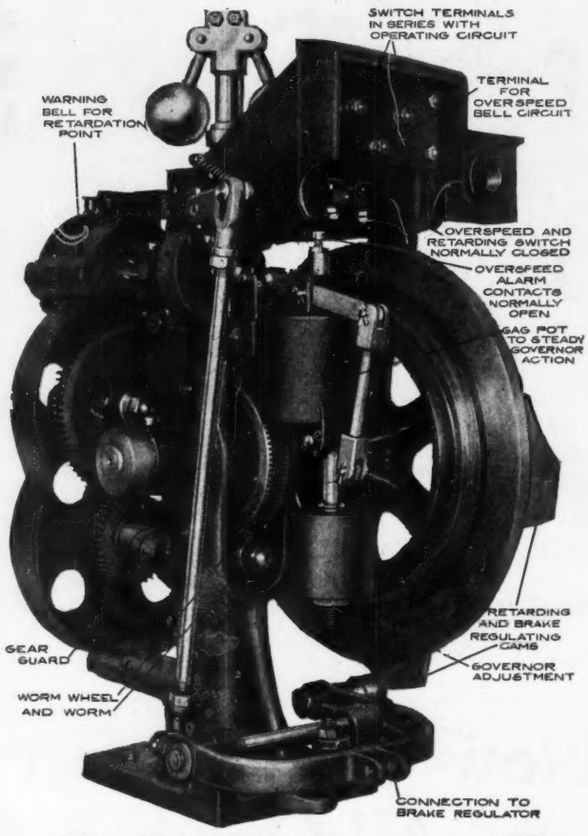
Metallurgical Chemicals Division

AMERICAN CYANAMID COMPANY

"Complete Metallurgical Chemical Service"

535 Fifth Avenue **New York**

FOLLOW THE LEAD OF THE GREAT MINING COMPANIES AND PROTECT YOUR HOISTS WITH LILLY CONTROLLERS


SWITCH TERMINALS IN SERIES WITH OPERATING CIRCUIT
TERMINAL FOR OVERSPEED BELL CIRCUIT
WARNING BELL FOR RETARDATION POINT
OVERSPEED AND RETARDING SWITCH NORMALLY CLOSED
OVERSPEED ALARM CONTACTS NORMALLY OPEN
SAG POT TO STEADY GOVERNOR ACTION
RETARDING AND BRAKE REGULATING CAMS
GEAR GUARD
GOVERNOR ADJUSTMENT
WORM WHEEL AND WORM
CONNECTION TO BRAKE REGULATOR

Lilly Hoist Controller Model "D"

(Note simplicity and accessibility)

If your hoist is protected by a Lilly Hoist Controller you need not worry if the hoist operator makes a mistake or is incapacitated while on duty. Lilly Hoist Controllers are protecting hoists in every continent in the world, and have been adopted by the leading Mining Companies, a few of which are as follows:

Anaconda Copper Mining Company
Calumet & Hecla Consolidated Copper Co.
Cleveland Cliffs Iron Company
Dominion Coal Company, Ltd.
Hollinger Consolidated Gold Mines, Ltd.
Old Ben Coal Corporation
Oliver Iron Mining Company
Oglebay, Norton & Company
Peabody Coal Company
Pickands, Mather & Company
Tennessee Coal, Iron & R. R. Co.
Tennessee Copper Company

Write for our catalogs, describing your hoists as fully as possible to enable us to send you suitable literature.

If you have a number of hoists, we will be pleased to make a survey of them and submit a report concerning their safety equipment, together with recommendations for modernizing it as fully as possible, or adding such equipment as may be necessary to insure proper protection, without placing you under any obligation.

DURO METAL PRODUCTS COMPANY

2649-59 North Kildare Ave.

Chicago, Illinois

"Canned Experience"

Make use of the other man's experience

That old saying about experience being the best teacher is absolutely sound. But most of us recite it without thinking that experience may be of various sorts—the experience of other men as well as our own, "canned experience," if you please, ready for use. Why not take advantage of the experience of other men as far as we can and save not only years of time but many expensive lessons?

Do you know that a large share of the world's best research work in the fields of science, technology and business is contained in

McGRAW-HILL BOOKS?

A single fact, a single table, a single idea may be worth many times the price of the book to you.

Buy your Books on the Budget Plan

Choose any of these McGraw-Hill Books that you would like to see—one, or two or half a dozen—as many as you wish.

Read them for ten days free—keep those you want—send back those you don't want.

If desired you may pay for the books on our monthly budget plan, provided your order amounts to $12.00 or more. The minimum monthly payment is $3.00 and the monthly installments must be large enough so that the entire account will be paid in full within six months.

There is no additional charge for books purchased on the budget plan. The prices are the same as for cash.

1

Ambronn and Cobb—

Elements of Geophysics—As Applied to Exploration for Minerals, Oil and Gas

By Dr. Richard Ambronn, Gottingen. Translated by Margaret C. Cobb, M.A., Ph.D. 372 pages, 6 x 9, 84 illustrations. $5.00.

An authoritative discussion of geophysical methods of exploration in mining and hydraulics, in the solution of water supply problems and as an auxiliary to geologic research work. The book summarizes the scientific background of geophysics and describes exact methods of geophysical procedure.

2

Lindgren—

Mineral Deposits—Third Edition

By Waldemar Lindgren, Professor of Economic Geology, Massachusetts Institute of Technology. Third edition, revised, enlarged and entirely reset. 1049 pages, 6 x 9. 313 illustrations, $7.00.

A thorough revision of this standard scientific treatment of economic geology. The book is a description, by classes and type examples, of the occurrence, structure and origin of the principal deposits of metallic and non-metallic minerals.

3

Kraus and Hunt—

Mineralogy

Second Edition—An Introduction to the Study of Minerals and Crystals

By Edward H. Kraus, Professor of Crystallography and Mineralogy and Director of the Mineralogical Laboratory, University of Michigan, and Walter F. Hunt, Professor of Petrology, University of Michigan. Second Edition. 604 pages, 6 x 9, 766 illustrations. $5.00.

A revision of this widely-used textbook. Excellent photographs of crystals and minerals supersede the conventional line drawings of crystals, and the treatment of the subject is vitalized as much as possible by the inclusion of chapters on the importance of mineralogy in modern civilization, on gems and precious stones, and on the production and uses of the important economic minerals. Numerous photographs and short sketches of distinguished mineralogists add a human touch.

4

Gruse—

Petroleum and Its Products

By William A. Gruse, Ph.D., Mellon Institute of Industrial Research. Mellon Institute Technochemical Series. 377 pages, 6 x 9. $4.50.

The first complete discussion in English of the properties, refining and utilization of petroleum, in a compact volume for the student and scientific investigator in this field. The information has been collected and the subject treated from the point of view of the industry in America.

5

Fairbanks—

The Laboratory Investigation of Ores—A Symposium

Edited by Ernest E. Fairbanks, Department of Geology, Buffalo, N. Y., Museum of Science; formerly Mineralogist, Rare and Precious Metals Experiment Station, U. S. Bureau of Mines, Reno, Nevada. Assisted by eleven contributors. 262 pages, 6 x 9, illustrated. $3.50.

A symposium by twelve specialists on the technique, the geological applications, the metallurgical applications and the history of the laboratory investigation of ores. An important feature of the book is the fact that it presents only such topics as have not received adequate treatment elsewhere.

6

Von Bernewitz—

Handbook for Prospectors

By M. W. von Bernewitz, Mining and Metallurgical Engineer; formerly Assistant Editor, Mining and Scientific Press. 319 pages, pocket size, flexible, 83 illustrations. $3.00.

A guide book for prospectors, giving sound practical information on equipment, methods of procedure and laws pertaining to mining. The book also presents those principles of mineralogy and geology which are of greatest practical aid in prospecting. Part III takes up briefly for reference use, the occurrence, description, detection and use of the various minerals.

7

Keffer—

Methods in Non-Ferrous Metallurgical Analysis

By Robert Keffer, Late Chief Chemist, Anaconda Copper Mining Company, in collaboration with Charles L. McNeil, Assistant Research Chemist, Anaconda Copper Mining Company. Prepared for publication by Allison Butts, Assistant Professor of Metallurgy, Lehigh University. 335 pages, 6 x 9, illustrated. $4.00.

A thorough presentation of analytical methods actually used in up-to-date laboratories of leading non-ferrous metallurgical companies. The methods cover the determination of all principal elements in non-ferrous metals, ores, intermediary products, etc., and are arranged so as to afford speed and accuracy.

8

Mineral Industry

Volume XXXVI—1927

Edited by G. A. Roush, in charge, Mineral Industries Division, Museum of the Peaceful Arts, New York. $12.00.

The latest technology in all fields and the statistics of production of all commercially important minerals made available many months ahead of other sources.

It is the indispensable tool of every metallurgist, mining engineer and chemist.

No industry has so complete and valuable an annual.

It is an exhaustive review, not only of a statistical but a general nature. Every article is the work of a specialist. Every commercially valuable metal from aluminum to zinc is covered in alphabetical order fully and authoritatively.

9

Wilson—

Ceramics—Clay Technology

By Hewitt Wilson, Associate Professor of Ceramic Engineering, University of Washington. Consulting Non-Metallic Engineer, Northwest Experiment Station, United States Bureau of Mines. 296 pages, 6 x 9. $4.00.

A treatment that has grown out of the data collected from ceramic literature, commercial factory practice, and experience in the class rooms of the Ohio State University and the University of Washington. The aim of the book is to furnish a detailed discussion of clay technology as an introduction to the field of ceramic engineering.

Choose the books you want to see—and just mail the coupon

Just mail this coupon to see these McGraw-Hill Books

McGraw-Hill Book Co., Inc., 370 Seventh Ave., New York
Send me the books checked for 10 days' free examination.

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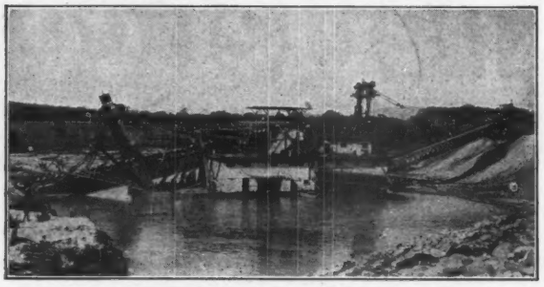

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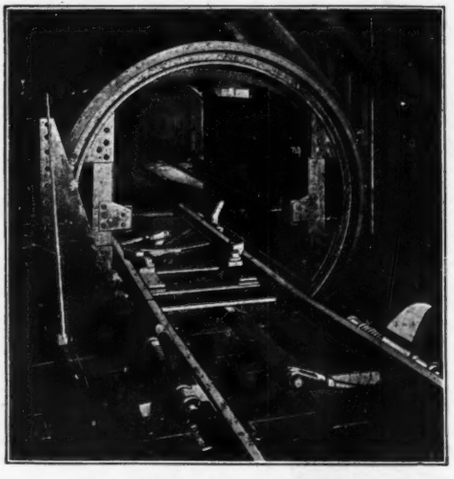

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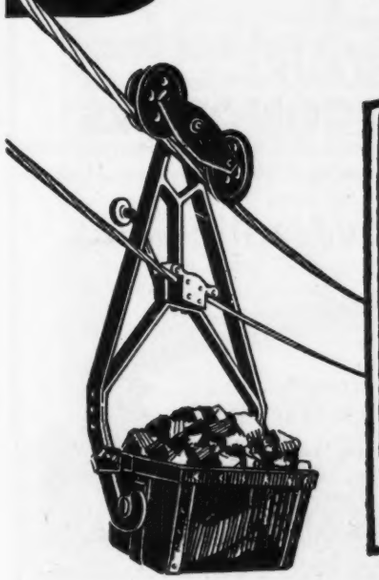

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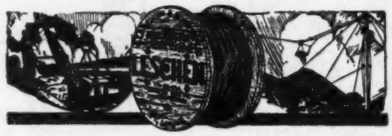

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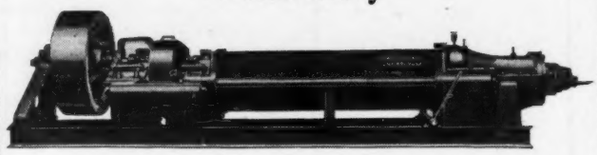

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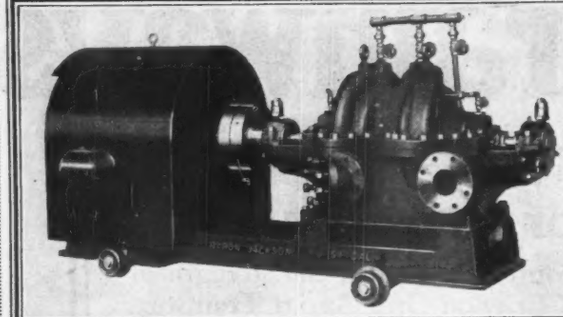

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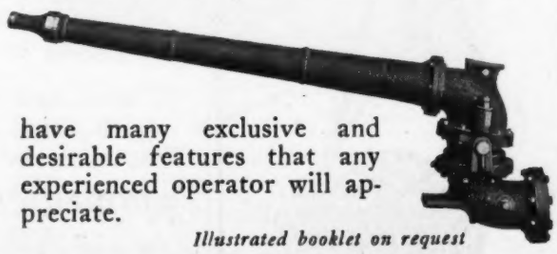

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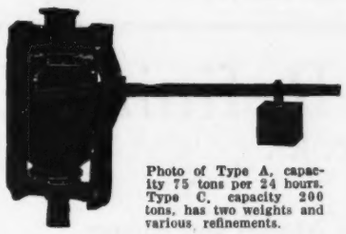

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WANTED immediately: Graduate mine surveyor, assayer, single, Colo. $150-175; 2 blast furnace foremen, east. U. S. and Mexico, $175-200; mine shiftboss, grad. single, Colo., under 35, $200; experienced concen. flot. mill draftsman, N. Y. C., $300; power plant designer, Mex., 4-6 mos. work, $350; mine shiftboss, practical, Cent. Amer., $210; several openings rec. grad. mine engr., U. S. $125-150; mill operator, repairman, Idaho, $165; Flot. mill shiftboss, east. U. S. $175 and trans.; topographical draftsman, Cent. Amer. single, $150-175; master mech. Mexico, $250. Apply Business Men's Clearing House, Denver, Colo.

33 MINING engineers, recent graduates and experienced engineers, as mine surveyors, samplers, shift bosses, foremen, U. S., and foreign, $150-275. Also graduate chemists and assayers, $150-190; smelter foremen, $200; mill operators and metallurgists, $165-200; mechanical structural draftsmen, designers, $200-250. Write or wire today. Interstate, Security Bldg., Denver, Colo.

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Tenth Ave. at 36th St., New York City.

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3—No. 8 Allis-Chalmers Gyratory Crushers, belt driven, manganese steel fitted.
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2—No. 5 Allis-Chalmers Gyratory Crushers.
2—No. 3-D Allis-Chalmers Gyratory Crushers.
2—9x15 Allis-Chalmers Blake Type Jaw Crushers.
3—10x20 Blake Type Jaw Crushers.
1—16x30 Fanel Blake Type Jaw Crusher.

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1—6-ft.x22-in. Hardinge Conical Ball Mill.
1—6x6-ft. Denver Ball Mill.

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2—45-in. Akins Classifiers.
2—54-in. Akins Classifiers.
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1—Model C Dorr Duplex Classifier, size 4 ft. 6 in. x 14 ft. 8 in.
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1—No. 43 Marcy.
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1—4x3-ft. Denver Engr. Works.
1—3-ft. Herman.

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1—No. 6 Gyratory.
1—No. 2F Telsmith, Gyratory.
1—9x15 Jaw, Blake type.
2—10x12 Jaw, Blake type.
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1— 80-ft. Rix, belted.

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1— 12-hp. Chicago Pneumatic, type AO.

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2—24x8-ft.x3-in. Fir.
1—24x7-ft.3-in. Fir.
2—16x7-ft.x3-in. Fir.
1—16x7-ft.x3-in. Redwood.
2—12x12-ft.x3-in. Redwood.
4—3x4-ft.x2-in. Fir.

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1—Denver Engineering Works Pulverizer.
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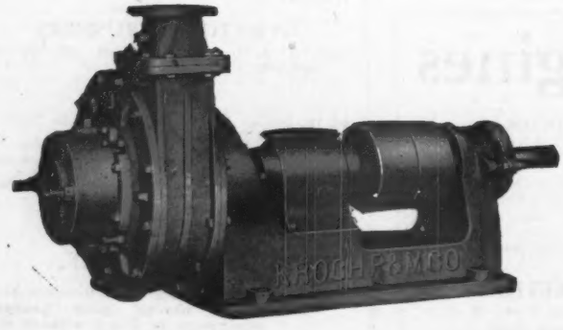

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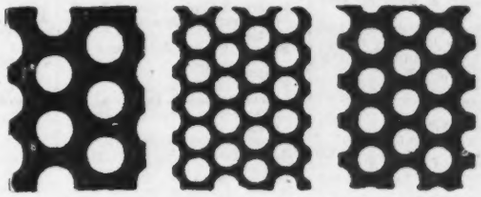

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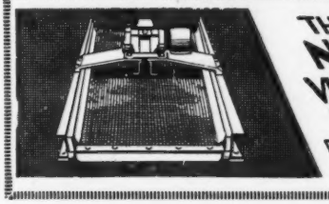

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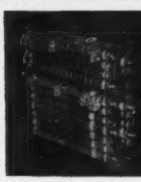

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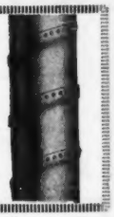

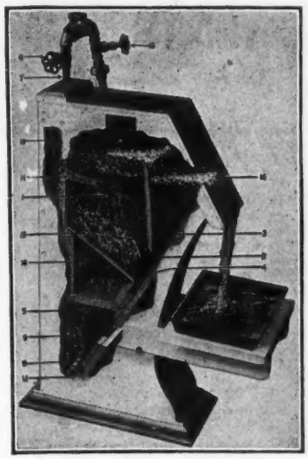

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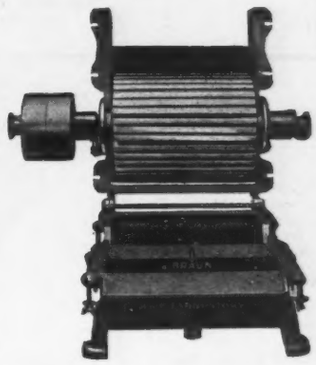

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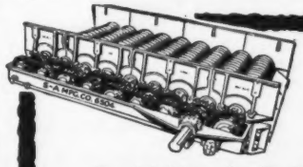

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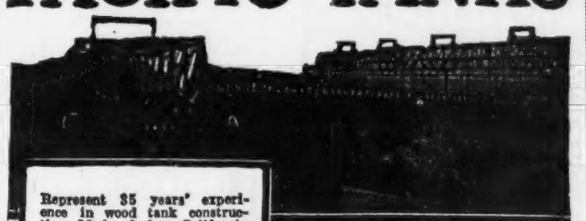

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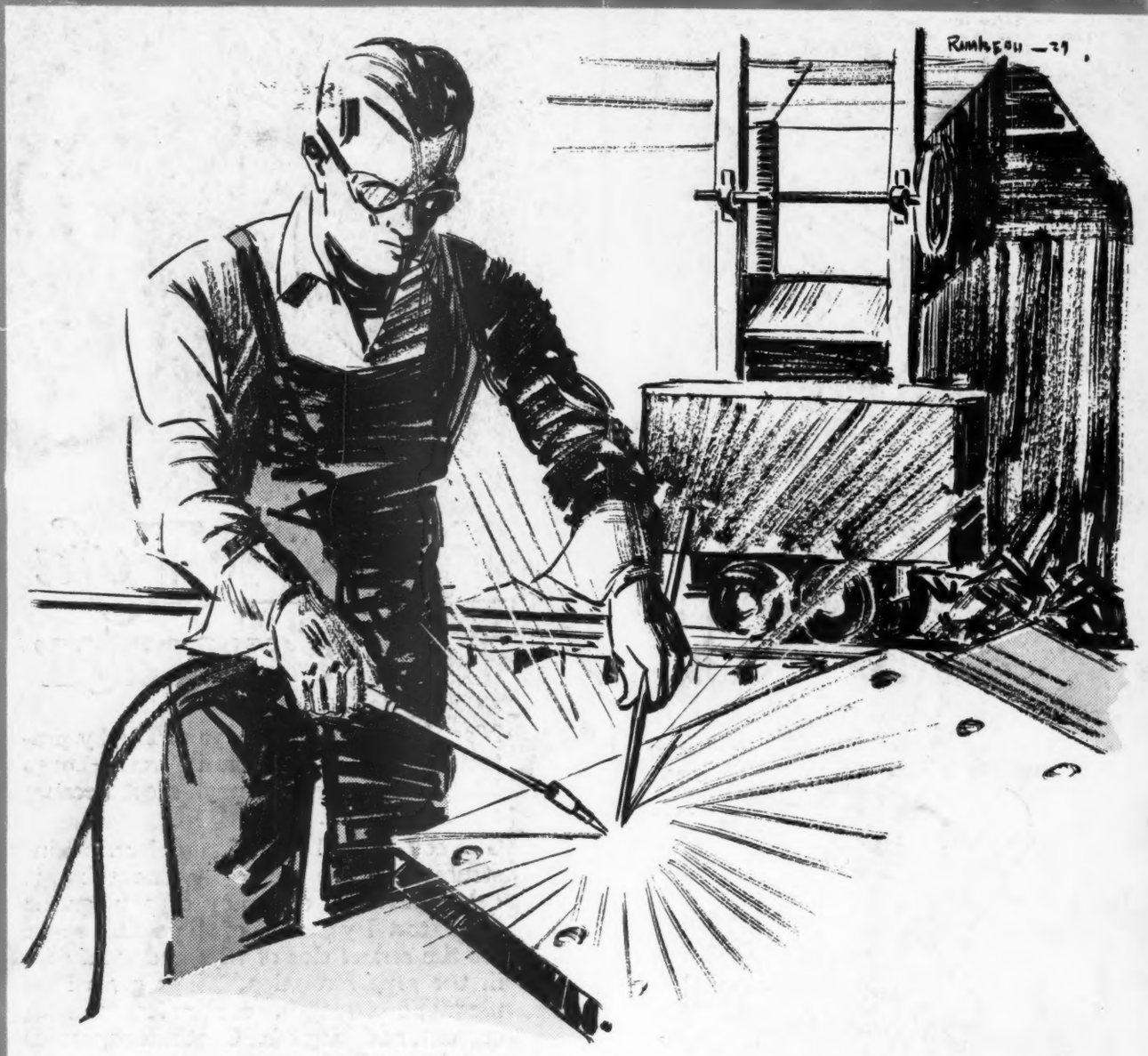

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